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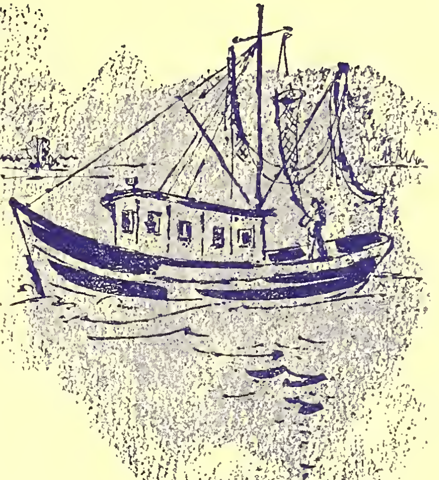

seventh

Biennial Report

STATE OF LOUISIANA

Wild Life and Fisheries Commission

1956 - 1957

SEVENTH

BIENNIAL REPORT

Louisiana Wild Life and Fisheries Commission

1956 - 1957

Published by
Division of Education and Publicity
Wild Life and Fisheries Commission
LOUISIANA WILD LIFE AND FISHERIES BUILDING
New Orleans, Louisiana

This Seventh Biennial Report
produced with the aid of
the Executive and Biological Personnel
of the Wild Life and Fisheries Commission,
and edited and compiled by
the Division of Education and Publicity,
Mel Washburn, Chief

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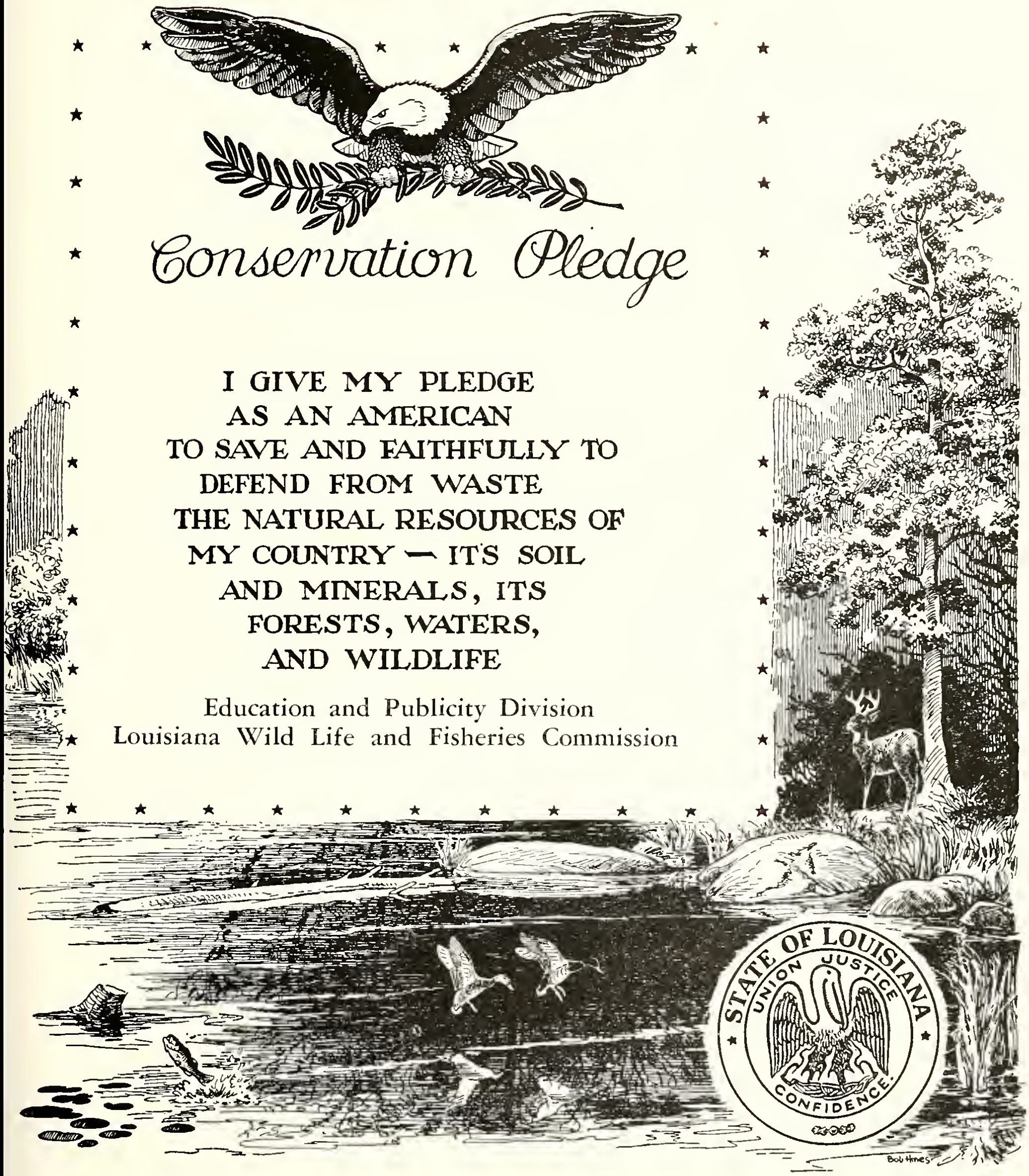
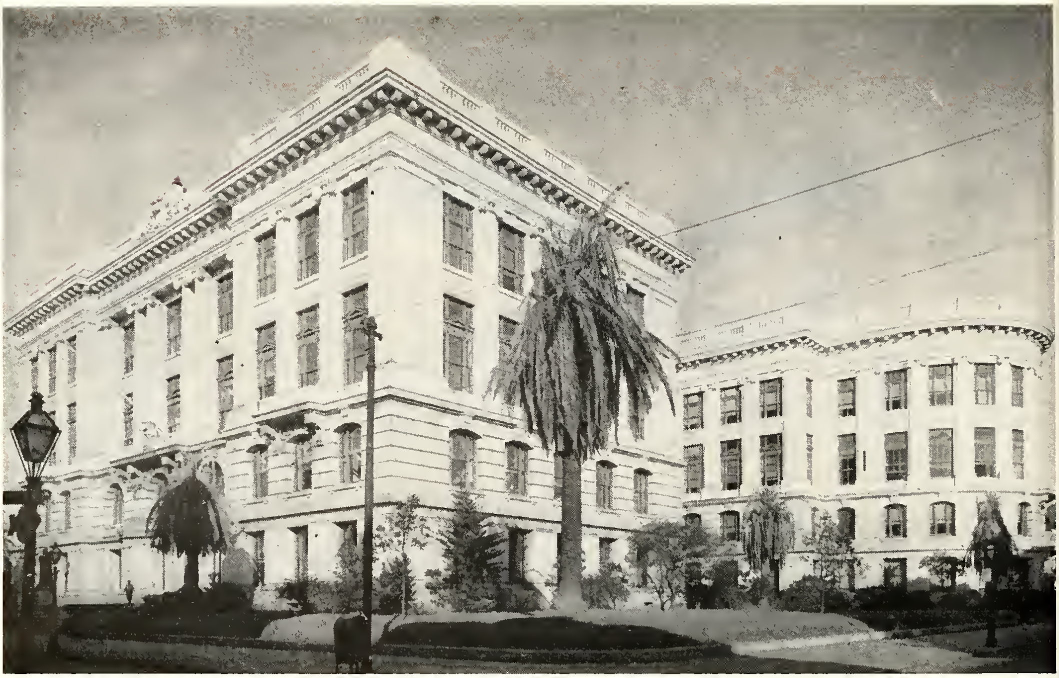
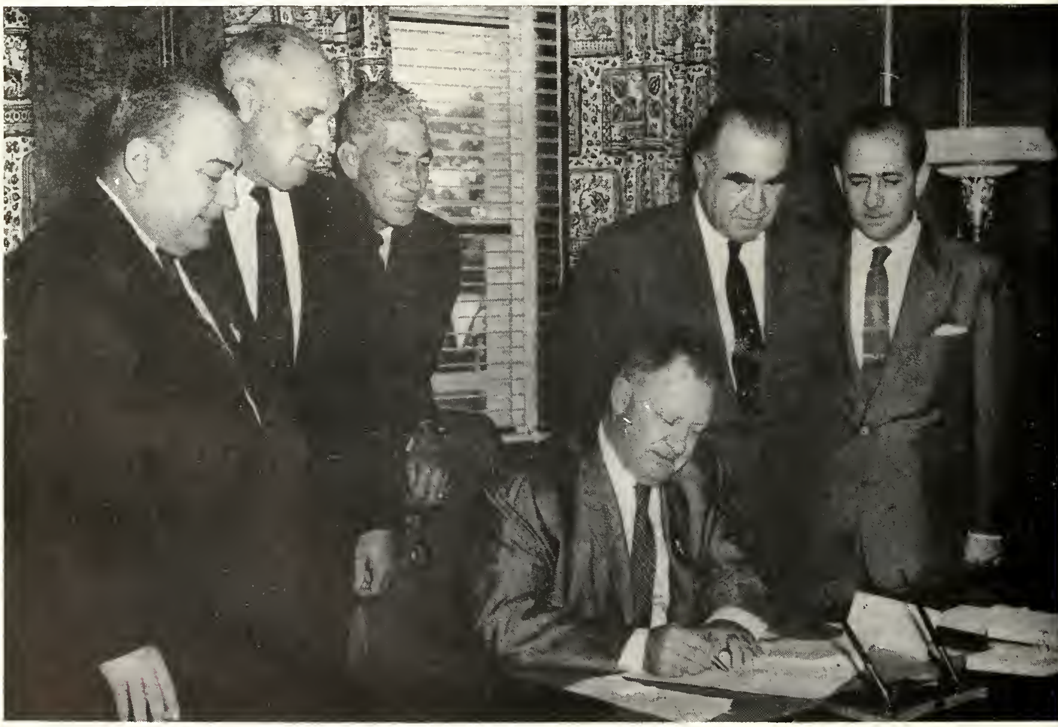


Conservation Pledge

I GIVE MY PLEDGE
AS AN AMERICAN
TO SAVE AND FAITHFULLY TO
DEFEND FROM WASTE
THE NATURAL RESOURCES OF
MY COUNTRY — IT'S SOIL
AND MINERALS, ITS
FORESTS, WATERS,
AND WILDLIFE

Education and Publicity Division
Louisiana Wild Life and Fisheries Commission





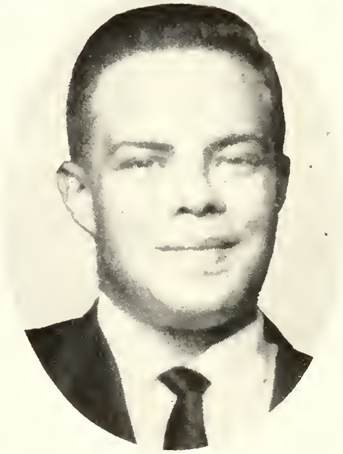
Governor Earl K. Long signing the bill passed by the 1957 Louisiana Legislature authorizing the purchase of the Civil Courts Building, above, from the City of New Orleans by the state of Louisiana for the Louisiana Wild Life and Fisheries commission. From left to right are Representative Edward F. Lebreton, Jr., Commission Director Lamar Clements, Representative E. J. Grizzaffi, Governor Long, Ernest S. Clements, former director of the commission, and Representative Samuel C. Cashio. The bill was authored by Representatives Lebreton, Grizzaffi and Cashio, after Ernest S. Clements had made the preliminary arrangements for the purchase of the building.

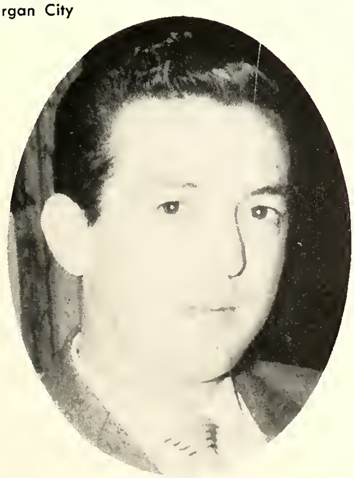
Louisiana Wild Life and Fisheries Commissioners

E. R. McDONALD
Newellton
Chairman

GEORGE A. FOSTER
Pollack
Vice-Chairmon

JOHN CUTRONE
Margan City


RAY WHATLEY
Alexandria


RALIEGH PITRE
Cut Off

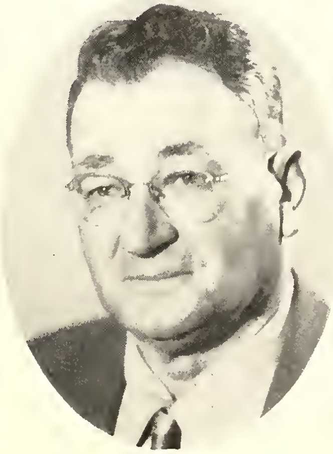

POLYCARPE BROUSSARD
Abbeville

Table of Contents

PAGE NUMBER

ADMINISTRATION DIVISION 1
  Accounting Section 5
  The Wharf 28
  Aviation Section 30

EDUCATION & PUBLICITY DIVISION 33

FUR DIVISION 37

DIVISION OF REFUGES 51

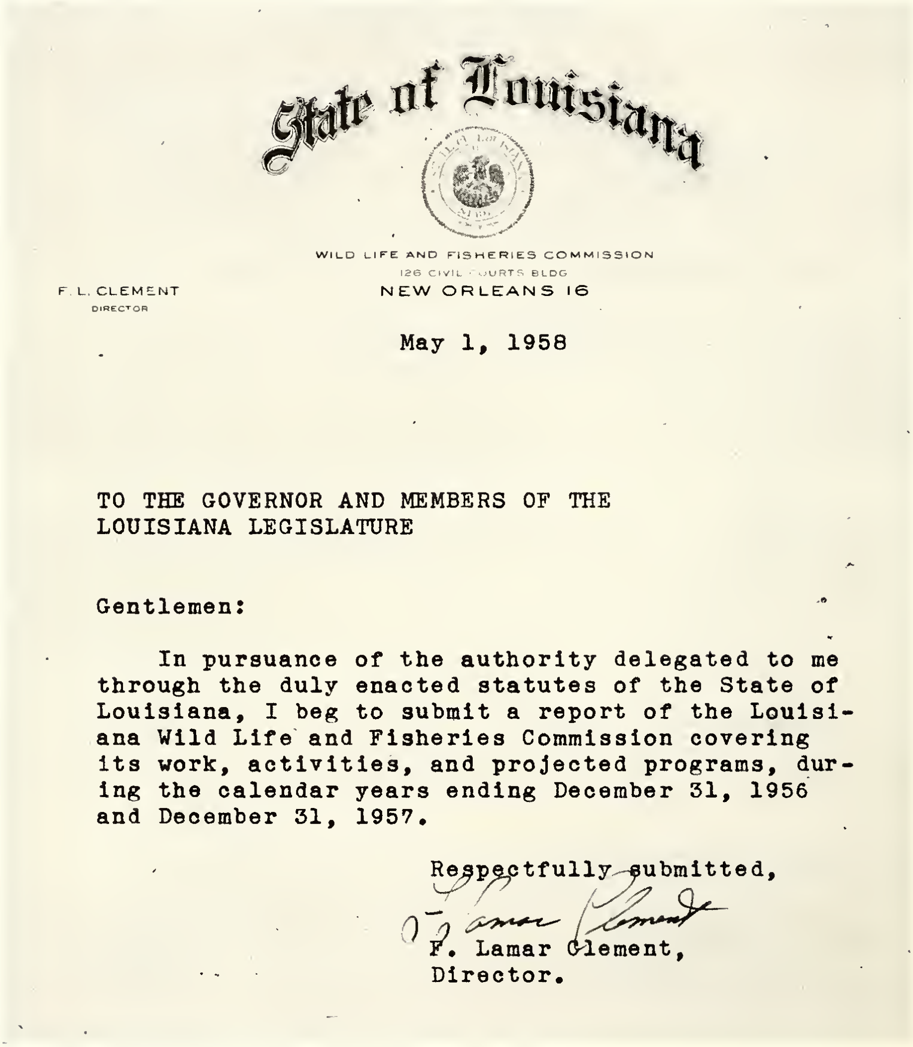
OYSTERS, WATER BOTTOMS & SEAFOODS 65
  Biological Section 71
  Seafood Section 96
  Coastal Waste Control 106

ENFORCEMENT DIVISION 107

WATER POLLUTION CONTROL 115

FISH & GAME DIVISION 125
  Water Hyacinth Control 133
  Fisheries Section 139
  Game Section 185

LETTER OF TRANSMITTAL



State of Louisiana
WILD LIFE AND FISHERIES COMMISSION
126 CIVIL COURTS BLDG
NEW ORLEANS 16

F. L. CLEMENT
DIRECTOR

May 1, 1958

TO THE GOVERNOR AND MEMBERS OF THE
LOUISIANA LEGISLATURE

Gentlemen:

In pursuance of the authority delegated to me through the duly enacted statutes of the State of Louisiana, I beg to submit a report of the Louisiana Wild Life and Fisheries Commission covering its work, activities, and projected programs, during the calendar years ending December 31, 1956 and December 31, 1957.

Respectfully submitted,

F. Lamar Clement

F. Lamar Clement,
Director.

ADMINISTRATION DIVISION

F. LAMAR CLEMENT

Director

THE past biennium has been a memorable one for the Louisiana Wild Life and Fisheries commission. During these last two years great strides have been made in modernizing and streamlining the administration of Louisiana's natural wildlife resources. Programs for better conservation, that were in effect when this commission came into being, have been continued and in many instances enlarged and broadened; new programs for better wildlife management and consequently better hunting and fishing have been inaugurated; considerable time and effort has been expended in the restoration of lost habitat; and a great amount of repair, reconstruction, and restoration of physical assets has been done.

Much of the progress made by this state agency is due to the guidance of a very capable Board of Commissioners. E. R. McDonald, of Newellton, chairman of the commission, is one of the foremost exponents of sincere conservation in Louisiana and in addition is a true sportsman, thus he is exceedingly well versed in the knowledge his position requires. George A. Foster, of Pollock, vice-chairman of the commission, is a re-appointee from the original commission and is also an ardent conservationist and sportsman; John Cutrone, of Morgan City, has for many years been identified with the fur industry both as an owner of fur producing lands and as a buyer and expert on fur quality; Ray Whatley, of Alexandria, is a young sportsman who, despite his youth, has been one of the foremost exponents of fish and game conservation in Central Louisiana; Raleigh Pitre, of Cutoff, comes from generations of men prominently identified with the fisheries industry; and Polycarpe Broussard, of Abbeville, is one of the foremost business men in his area and has had extensive experience in the fur industry and is one of the leading sportsmen of Southwest Louisiana.

ERNEST S. CLEMENTS

F. LAMAR CLEMENT

With a commission such as this, Louisiana's natural wildlife resources are now in the hands of men well versed in all phases of wildlife management and at the same time men who realize the advantages advanced science makes possible.

When Earl Long became Governor again in 1956 and subsequently read out the existing commission at that time by legislative action, he once more appointed Ernest S. Clements to administer the activities of this state agency until the new commission had been appointed. Following the appointment of the new Wild Life and Fisheries commission board, Mr. Clements was unanimously approved by them as Director and served in that capacity until his resignation on December 14, 1956, to become a member of the Louisiana Public Service commission. During Ernest S. Clements' approximate seven-month tenure of office he was obligated to renovate, rejuvenate, and rearrange the affairs of the commission so that it once more became a smooth functioning department of the state. It was necessary to renovate and repair virtually the entire fleet of boats operated by the commission; to completely overhaul the club property at Pass-a-Loutre; to repair or rebuild a number of camps used by the oyster, water bottoms and seafood division, as well as make a complete renovation of the general offices of the commission at its headquarters in the Civil Courts building in New Orleans.

WARREN M. SIMON
Commission Attorney

During that time, Director Clements was also instrumental in negotiating for the purchase of the Civil Courts building, from the City of New Orleans, to provide a permanent domicile for the commission. This negotiation culminated in the commission purchasing the building along with the juvenile court building on Chartres Street for a total of $1,100,000.

Programs that had been approved and inaugurated as a result of biological studies were continued with augmented impetus under Clements' administration and new activities inaugurated. It has been generally conceded that during the seven months Ernest S. Clements served as Director under the new commission, some of the most outstanding programs for progress during the entire history of this state agency were instituted. One of these was the completion of plans to build a new and completely modern marine laboratory on the Fort Livingston site on Grand Terre island across the Pass from Grand Isle. This new laboratory, now under construction, aside from its strategic location, will provide the Wild Life and Fisheries commission's marine biologists ample opportunity for exhaustive study of Louisiana's fisheries industries, particularly those phases dealing with shrimp and oysters.

Immediately following Ernest Clements' resignation, the commission, by a unanimous vote, appointed F. Lamar Clement as Director. The new Director is a widely known business man of Minden, Louisiana, and immediately upon his appointment, announced his determination to carry on the programs under which the commission was making such rapid headway.

One of the foremost things that plagues Louisiana's hunters today is finding some place to hunt. The Wild Life and Fisheries commission has had this problem in mind at all times and there are now 23 dedicated areas in Louisiana for public shooting. These 23 public shooting ground areas run the gamut as far as types of hunting are concerned, and they are so situated over the state that some one of them is of fairly easy access to some hunters.

There is the Pass-a-Loutre public shooting grounds and its annual wild waterfowl hunting program where, although this past season was definitely disappointing, some of the finest duck and geese and coot shooting in the entire state may be enjoyed. This Pass-a-Loutre area has also provided good hunting in many instances for deer and rabbits.

During the past year the commission acquired a new 10-year lease on the 30,000-acre Wisner Tract of marshland between Leeville and Grand Isle, and before the 1958-59 waterfowl season opens it is hoped to have this area available as a public shooting ground.

The commission has also completed investigation and made the initial lease agreement on 40,000 acres of marshalnd, adjoining Lake Borgne, which will become a public hunting domain principally for waterfowl and small game.

The Commission has succeeded in acquiring a general agreement on the Bodcau area in Bossier and Webster parishes, and extended the work on this area to include upland game species along with the others. It has leased and completed plans for hunting on the Bonnet Carre Floodway above New Orleans and hopes to provide good rabbit, squirrel, and quail shooting along with its wild waterfowl possibilities, there also.

It has started a public quail development project on 16,000 acres in the Bogalusa area in cooperation with the Gaylord Container corporation and this tract should provide some excellent hunting, not only for quail but for small game, during the coming years.

Eight game management areas, or wildlife preserves, in the state, were opened for controlled squirrel hunting this past year; three of these areas were open for a short deer season and two of them had quail hunting under game management supervision.

In addition, there are seven game management districts in the state, and in each of these are two 1,000-acre tracts, each containing a fenced food plot, and in each district, one of these 1,000-acre areas is dedicated to public hunting.

In addition to these public shooting grounds now in existence, there are several more in prospect as a result of investigations made by this commission during the past year, and proposals for the establishment of additional public shooting and game management areas.

In connection with endeavors to provide places for Louisiana's hunters to enjoy their sports afield the commission has carried on an extensive game management program with district biologists keeping in constant touch with fish and game conditions in every section of the state. These men have trapped and transplanted more than 300 deer for restocking in areas where no deer existed, but where there was suitable habitat to maintain a deer herd.

Most amicable relations with the Louisiana Forestry Commission for the preservation of game habitat, for the prevention of disastrous fires and for the protection of much of our mast bearing trees so necessary to several of our game species, have been established.

Although there has not been a day in the year that we have not been mindful of the future of Louisiana's hunters, we have devoted as much if not more consideration to fishing conditions and potentialities. There is no need to repeat that Louisiana is blessed with the finest fishing of all kinds, of any state in these United States, and unlike so many states has equally attractive fresh and salt water possibilities for our anglers.

Fishing pleasure is constantly increasing and we must keep abreast of the trend of the times in improvements in fisheries management if we are to have continued good fishing. Taking a strictly modern view, the future of fishing is virtually solely dependent upon our fish research, and efforts in this direction have been greatly magnified during the last year. This research takes time and money and must of necessity enlist the help and cooperation of everyone if Louisiana is to be kept the best fishing area in this country. At the present time there are seven fishery biologists, two biologist s aids, seine fishermen, laborers, and even part-time student help, working in one section of the fish and game division in connection with fish research, lake management, and the rehabilitation of fresh waters in Louisiana.

Under the Dingell-Johnson Federal Aid program there are currently four research projects underway. The oldest of these projects is in its sixth year which shows that fish research in poisoning consists of applying a light dose of rotenone which kills only the trash fish. Audubon Park in New Orleans was treated and 1,200 pounds of gizzard shad were removed. Bayou DeSiard at Monroe gave up more than 52 tons of shad after the application of $2,000 worth of rotenone in this 811-acre lake. These shad were buried in the city dump and will be used as fertilizer next year in the city park gardens. This job was considered very successful as recently only two shad were caught in a period of two weeks of fishing with more than a thousand yards of gill and trammel nets. Since these shad were removed dozens and hundreds of people have been catching their limit of bass, bream and crappie daily.

Cane River Lake was again selectively poisoned during the fall of 1957 with a good kill of thread-fin shad and these waters have again become some of the finest fishing waters in the entire south.

During the past year, 135 ponds were checked, 10 permits were issued to owners for the use of rotenone in their private ponds, and the three state fish hatcheries located at Lacombe, Forest Hill and Monroe produced over 800,000 blue gills and bass, 175,000 large mouth bass and 105,000 crappie. More than 100,000 fish were rescued from lakes and pits that were drying up and more than 2,000,000 fish were stocked in Louisiana waters during the past year; 900,000 of these were obtained from the Federal hatcheries at Natchitoches and were placed in Iatt Lake, Old River Lake in Beauregard parish, Sam Houston State Park Lake, Swan Lake, Cross Lake, Whiskey Chitto Lake, Black Lake, Joe's Bayou, Sixmile Lake, Cocodrie Lake near Forest Hill, Concordia Lake, Tew Lake, Lake St. John, Jones Bayou, Twin Lakes, Bayou Louis and Grassy lake.

In order for these fish to live they must have unpolluted waters. As a result of the concentrated efforts of the Division of Water Pollution Control of the Stream Control commission, which works in conjunction with the Wild Life and Fisheries commission, great improvements have been made, especially in the sugar cane growing areas of the state, and the year 1957 saw the virtual elimination of this type of pollution. Some of this success may be attributed to the extremely wet season experienced during the cane grinding time, therefore affording more dilutioned water in the streams but this condition, too, had its drawbacks. One thing, the cane was very muddy when it came from the fields and had to be washed before grinding. This had been a major source of pollution until the Stream Control commission forbid the discharge of cane washing water into a stream. Our cold weather froze much of the cane in the field, made it sour even before grinding, but despite this 1957 yielded a bumper cane crop. . .some say the biggest in 50 years. . . and this brought about mill overloading and a longer grinding season. Despite this we managed to maintain the waters of the state in good condition in almost every cane grinding area.

After the Corney Lake hearing near the Arkansas border in January, 1957, this water shed and the D'Arbonne will recover from the pollution once caused by Arkansas oil field brines. This hearing was the first ever to be held on interstate pollution and the U. S. Public Health Service deemed it a hugh success, partially because of the excellent data gathered by the Water Pollution Control division of the Wild Life and Fisheries commission.

CHARLES LANGE
Assistant Director

The Stream Control commission called upon Arkansas to clear the Ouachita river of pollution so that the state's northeastern communities could enjoy this stream as a source of domestic water supply and for recreation.

Because of Federal monies received from the Public Law 660, the commission is about to almost double its water pollution control research and enforcement staff. Louisiana is now receiving more and better coverage of all our waters, because of this fact and it is hoped that we will continue to receive these funds so that our over-all program may advance our knowledge and clear our streams of existing and future pollution.

The state's commercial fishery industries have commanded and deserved an equal amount of attention. In some instances it has been necessary to allot even more consideration to the well-being of our fishery industries. Conferences with representative groups of both the shrimp and oyster people have been held and have been able in some instances to provide needed remedies, and in others to formulate plans that it is hoped will eventually solve at least the major problems that confront both of these vital resources.

During and immediately after Hurricane Audrey struck with such drastic consequences in the Southwest parishes, almost the entire law enforcement personnel was mobilized as a rescue corps and was responsible for the saving of hundreds of lives. Under the supervision of Chief Rudolph Easterly, every available game agent in the state assembled in the hurricane area with boats and motors as well as airplanes and the rescue work got quickly underway.

Following the storm, the restoration and rebuilding program was necessary on several of our outstanding wildlife sanctuaries, principally the Rockefeller Refuge, State Wildlife and Marsh Island. Buildings that were destroyed have been replaced.

Water empoundments have been restored so that today

HORACE DUGAS
Former Member of Commission

there are few reminders of the havoc and destruction left in the wake of this disaster.

In connection with the fur industry and Louisiana's annual fur harvest, the commission can report progress on a par with other divisions in the commission. Only recently there was held a conference in New Orleans with some of the outstanding men in the United States connected with wildlife, and particularly rodent control, for a discussion of the nutria problem that has become so important. There is little doubt that eventually the nutria will become one of the most valuable fur-bearing animals, but today the state is faced with the fact that this rodent has become a destructive part of our wildlife. It is hoped to eventually create a demand for nutria pelts in the fur markets of the world, that will increase the trappers' interest in this animal. Until that possibility becomes a fact rather drastic measures for control must be used.

During the last year, enforcement of fish and game laws has been of primary interest. During the year 1957, 1,902 violators of either fish or game laws were apprehended and convicted. As a result, a total of $60,808 in penalties was collected in Justice of the Peace courts, $17,580 by District courts and $13,720 by Federal courts and none of this money comes back to the Wild Life and Fisheries commission.

Imbued with the belief that only an enlightened public can be converted to true conservation and sportsmanship, the commission has exerted every effort toward the education of all Louisiana in wildlife in general. To do this it has used every media available. Foremost in this respect is the monthly publication, the LOUISIANA CONSERVATIONIST, which now goes to more than 52,000 persons free of charge, telling the story of every phase of the commission's conservation work. In addition, it has used television, radio, newspapers, magazines, periodicals and news releases to keep all Louisiana as much informed as possible regarding the work of the Board of Commissioners and the entire commission personnel. Special exhibits for the major fairs throughout the state have been provided and even more are planned for this coming year.

There are many phases to be considered in the obligations of the Louisiana Wild Life and Fisheries commission and certainly one of the more important of these is the maintenance of equipment. During the past year we have virtually perfected our own radio network throughout the state making it possible now to communicate with any area in a few seconds or, at most, a few minutes. This has greatly enhanced the law enforcement program as well as providing a communication system for every division in the commission. We are maintaining boats, automobiles and airplanes for law enforcement patrol work, for our shrimp, oyster and fish survey work, and in some minor instances to enhance our public relations and in a number of instances for rescue work.

During the past year the Civil Courts building in New Orleans was bought to provide a permanent home for the Louisiana Wild Life and Fisheries commission and it will take complete and entire possession of the building as soon as the courts and other state offices have moved to their new domiciles now being constructed.

When we take over the entire court building it is planned to install one of the most complete and modern wildlife museums in the country. When we acquired the Civil Courts building we also acquired a very substantial building across the street from it that now houses the Juvenile court of the City of New Orleans which will also be moved to a new home and at that time it is planned to convert that building into a complete and modern laboratory where biologists and scientists may conduct their various types of experiments attendant to their work.

One of the programs of the commission is the water hyacinth control program. It has attained acceptable control of this plant on Lake Bistineau and Wallace Lake, Black Bayou Lake, and other bodies of water near Monroe. Saline, Black and Clear Lakes, in Natchitoches parish, and the vast waterways of Avoyelles parish near Marksville.

Had we not had such a program in effect these waters would have been virtually unusable for fishing and hunting. Aside from these accomplishments, excellent progress has been made in the control of water hyacinths in the Atchafalaya Spillway section, from Henderson to Charenton, including that part of Northern Iberville parish used by hundreds of sportsmen from Baton Rouge. This pest no longer poses a problem in the Ramah Pits, Grand river, Bull Tail, and Pat's Bay, known to many as tops for fishing.

Those who have enjoyed hunting and fishing in the Florida parishes have noticed the absence of water hyacinth in their favorite streams and lakes there. To name a few, there are: Tickfaw, Blood, Amite, Tangipahoa, Natalbany and Pearl rivers, along with Yellow Lake, Colyell Bay, Alligator Bayou and Old River.

The complement of workers in this program is 60 men, with the necessary boats, equipment and chemicals comprising an inventory of about $50,000.

These things are by no means all that has been done by the Wild Life and Fisheries commission, but only the highlights of their work.

Despite the fact that every member of the personnel of the Wild Life and Fisheries commission is now better paid than ever before; despite the fact that materials and equipment cost considerably more today and maintenance of all kinds has increased in expense; and despite the fact that due to acts of God, such as storms and high water, we have had much added expense, yet because of the practice of the strictest economy, the Wild Life and Fisheries commission operated throughout the year of 1957 on a smaller budget than in the last number of years.

ACCOUNTING SECTION

ROY B. SCHAEFER

Chief Accountant

THE ACCOUNTING SECTION is responsible for maintaining all records and collections of revenues, financial reports, statistical reports, purchasing, pay roll, budgetary reports, field audits, and payment of all invoices.

The following exhibits furnish a detailed analysis of these functions.

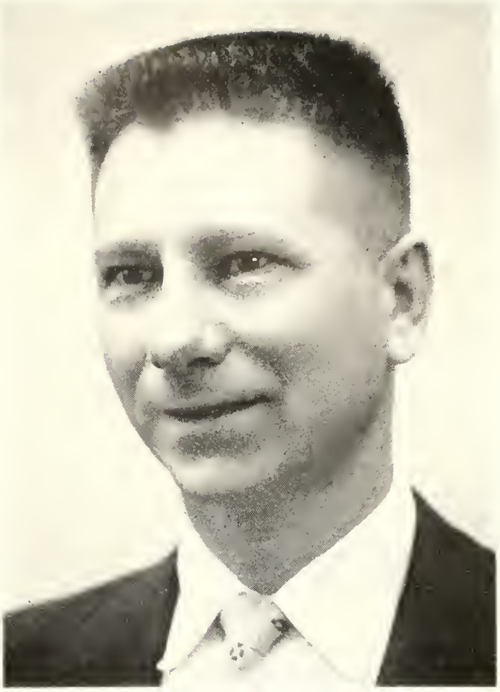
The operating funds for the Commission are appropriated by the Legislature from the Conservation Fund, into which are paid revenues from the sales of hunting, fishing and commercial fishing and trapping licenses, oil leases and royalty revenues, sulphur severance taxes and other miscellaneous taxes.

Exhibit 1 shows a detailed analysis of these revenues for the fiscal year 1957 and an estimated amount for fiscal year 1958. The operating appropriation is allocated to the seven divisions. A detail of the expenditures by Divisions is shown in Exhibit 2.

Accounting

Index to Accounting and Statistical Reports

Operating Revenue Receipts & Pie Charts .. Exhibit 1
Operating Expenditures by Divisions and Pie Charts .... Exhibit 2
Pittman-Robertson Account .... Exhibit 3
Dingell-Johnson Account .... Exhibit 4
Oyster Seed Ground Account .... Exhibit 5
Commercial Seafood Account .... Exhibit 6
Rockefeller Refuge Account .... Exhibit 7
Marsh Island & State Wild Life Account .... Exhibit 8
Water Hyacinth Control .... Exhibit 9
Special Funds .... Exhibit 10
Total Barrels Various Types Processed Shrimp 1946-55 & 1956 & 1957 .... Exhibit 11
Monthly Shrimp Production .... Exhibit 12
Shrimp Production Processed in Each Area 1956 .... Exhibit 13
Shrimp Production Processed in Each Area 1957 .... Exhibit 14
Shrimp Production & Number of Trawls .... Exhibit 15
Number of Resident & Non-Resident Trawl Boats 1956 .... Exhibit 16
Number of Resident & Non-Resident Trawl Boats 1957 .... Exhibit 17
Menhaden Production by Units .... Exhibit 18
Yield Louisiana Menhaden Production .... Exhibit 19
Value Louisiana Menhaden Production .... Exhibit 20
Comparative Statement Fresh & Salt Water Fish Produced .... Exhibit 21
Statement of Licenses Sold by Parish 1956 .. Exhibit 22
Statement of Licenses Sold by Parish 1957 .. Exhibit 23
Comparative Take of Fur Animals .... Exhibit 24
Number of Fur Licenses Sold .... Exhibit 25
Number of Hunting Licenses Sold .... Exhibit 26
Number of Angling Licenses Sold .... Exhibit 27
Angling, Hunting & Trapping Licenses by Parish .... Exhibit 28
Civil Fees For Law Violations .... Exhibit 29



ROY SCHAEFER

The Federal Aid program in Fish and Wildlife restoration represents the culmination of concerted efforts by wildlife and fishery conservation organizations throughout the United States to accelerate the restoration of natural conditions as a means of increasing the supply of wild life and fish of recreational value. Wildlife activities under the program were inaugurated on July 1, 1938, with the appropriation of the first funds to implement the authorizing legislation known as the Pittman-Robertson Act, approved September 2, 1937. Similar authorizing legislation in the field of fish restoration and management did not become a reality until the passage and approval, on August 9, 1950, of what is popularly known as the Dingell-Johnson Act. In each case, funds are made available from the revenue collected through manufacturers' excise taxes, one on sporting arms and ammunition, the other on sport fishing tackle. These funds are appropriated among the states as follows:

(1) Pittman-Robertson: Expenses in administration and execution of this Act are deducted, not to exceed eight per centum, then the remainder is apportioned among the States in the following manner: one-half in the ratio which the area of each State bears to the total area of all the States and one-half in the ratio which the number of paid hunting license holders of each State in the preceding fiscal year bears to the total number of paid hunting license holders of all States.

(2) Dingell-Johnson: Expenses for necessary investigations, administration, and the execution of this Act are deducted, not to exceed eight per centum, then the remainder is apportioned among the States in the following manner: forty per centum in the ratio which the area of each State including coastal

> and Great Lakes waters (as determined by the Secretary of the Interior) bears to the area of all the States and sixty per centum in the ratio which the number of persons holding paid licenses to fish for sport or recreation in the State in the second fiscal year preceding the fiscal year for which such apportionment is made bears to the number of such persons in all the States.

Funds appropriated annually by the Congress remain available for obligation until the close of the succeeding fiscal year, and unspent funds, upon completion of a project, under certain conditions are available for obligation of future projects. The State must match these funds—25 cents to every 75 cents appropriated by the Federal Government.

Exhibits 3 and 4 show the money available from the Federal Government and an analysis of the expenditures of Pittman-Robertson and Dingell-Johnson accounts, respectively.

Act 533 of 1950, Section 458, establishes dedicated revenues for Oyster Seed Ground and Commercial Seafood. The revenues are derived from a severance tax placed on shells dredged from state-owned water bottoms, and are equally divided between the Oyster Seed Ground and Commercial Seafood.

ROGER HUNTER
Supervisor of Revenue

Expenditures from the Oyster Seed Grounds Account are for the planting, propagation, cultivating, policing, preservation and distribution of oysters. While expenditures of the Commercial Seafood Account are for the administration and enforcement of commercial seafood laws.

These expenditures and an accounting of the funds are shown in Exhibits 5 and 6.

The Exhibits 7 and 8 presenting an alaysis of the Rockefeller Refuge Account, and Marsh Island and State Wild Life Account, respectively, furnish an accounting of the dedicated funds received from acts of donation. The Rockefeller Refuge located in Cameron and Vermilion Parishes, consisting of 85,000 acres of marshland, is richly endowed with oil and gas. These revenues from the leases and royalities are deposited in the Rockefeller Fund in Baton Rouge from which the Legislature appropriates monies to operate and maintain the refuge. The Federal Fish and Wild Life Service is the supervising agency. Their function is to see that the provisions in the deed of donation are complied with and that all expenditures are properly charged.

Marsh Island and State Wild Life Refuge are areas donated to the State, with the provision that they be maintained by this Commission as a permanent sanctuary for waterfowl and wild life and all revenues derived from these areas be expended directly on the refuges for upkeep and further development. The Russell-Sage Foundation is the supervising agency for the Marsh Island Fund and require strict compliance with the deed of donation. Funds deposited in the Marsh Island (Russell-Sage) Account in Baton Rouge may be drawn when needed for the upkeep and development of Marsh Island or any other refuge.

One of the many large shrimp boats capable of trawling in the Gulf of Mexico.

The Commission receives a specific appropriation for the Water Hyacinth Control Program. This appropriation is used in the eradication of Hyacinths, thereby providing many thousands acres of water area for commercial and sport fishing and free navigable waterways. Exhibit 9.

The Special Funds as shown in Exhibit 10 were appropriated for the specific purpose as shown.

A Louisiana Shrimp cannery in operation

EXHIBIT 1

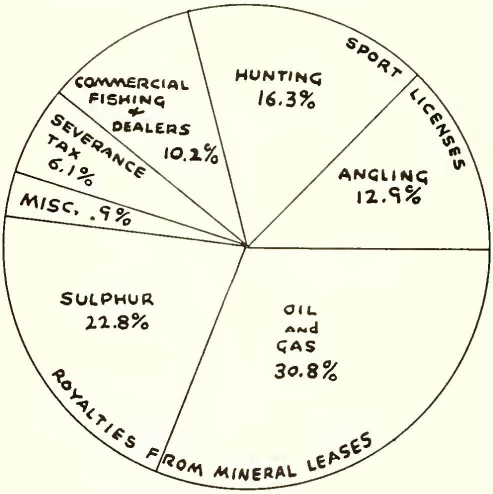
OPERATING REVENUE RECEIPTS
ACTUAL RECEIPTS 1956-1957
ESTIMATED RECEIPTS 1957-1958

Type of Revenue	Actual 1956-57	Estimated 1957-58
Sport Licenses:		
Angling—New Orleans	33,091.00	35,000.00
Angling—Other Parishes	198,559.02	200,000.00
Total Angling	231,650.02	235,000.00
Hunting—New Orleans	18,571.75	18,000.00
Hunting—Other Parishes	273,013.76	275,000.00
Total Hunting	291,585.51	293,000.00
Commercial Fishing & Dealers: (Includes Fish, Shrimp & Oyster)		
Commercial Fisherman	5,400.00	5,500.00
Hoop Net	8,995.00	9,000.00
Fresh Water Seine	1,730.00	1,800.00
Fresh Water Trammel Net	5,335.00	5,500.00
Fresh Water Gill Net	18,695.00	18,500.00
Salt Water Fish & Shrimp Seine	510.00	500.00
Salt Water Trammel Net	1,490.00	1,500.00
Salt Water Menhaden Seine	4,150.00	4,500.00
Oyster Vessel Tonnage	1,441.50	1,500.00
Oyster Dredging	9,600.00	10,000.00
Salt Water Fish Vessel	255.00	10,800.00
Salt Water Menhaden Vessel	4,200.00	4,500.00
Salt Water Shrimp Trawl & Vessel	39,625.00	4,200.00
Salt Water-Shrimp Freight	2,480.00	2,500.00
Oyster Bedding Ground	48,463.00	50,000.00
Oyster Shop & Resale	985.00	1,000.00
Wholesale Dealer	14,900.00	15,000.00
Wholesale Dealer's Agent	810.00	800.00
Retail Dealer	13,380.00	13,500.00
Total Comm. Fishing & Dealers	182,444.50	160,600.00
Severance Tax:		
Gravel	6,081.75	6,000.00
Sand	5,651.00	5,000.00
Fur	30,715.18	32,000.00
Oyster	16,578.38	15,000.00
Shrimp	51,051.92	40,000.00
Total Severance Tax	110,078.23	98,000.00
Miscellaneous Licenses & Receipts:		
Hunting Club	920.00	950.00
Game Breeder	770.00	800.00
Oyster Transfer of Lease	18.00	20.00
Resident Fur Buyer	3,325.00	3,300.00
Resident Fur Dealer	3,150.00	3,200.00
Non Res. Fur Dealer	600.00	900.00
Trapper—New Orleans	324.00	500.00
Trapper—Other Parishes	7,461.20	7,500.00
Total Misc. Licenses & Receipts	16,568.20	17,170.00
Royalties from Mineral Leases:		
Oil & Gas	552,845.96	570,000.00
Sulphur	408,966.61	500,000.00
Total Royalties	961,812.57	1,070,000.00
TOTAL OPERATING REVENUE	1,794,139.03	1,873,770.00

OPERATING ACCOUNT

Means of Financing:	Actual 1956-1957	Estimated 1957-1958
State Appropriation	$1,970,031.00	$1,897,493.00
Federal Appropriation—Water Pollution	31,766.00	55,852.00
Total Appropriation	$2,001,797.00	$1,953,345.00
Total Expenditures	1,939,346.13	1,897,493.00
Refund to State Treasurer	$ 62,450.87	$ 55,852.00

Actual Revenues for the Fiscal Year 1956-1957



Estimated Revenues for the Fiscal Year 1957-1958

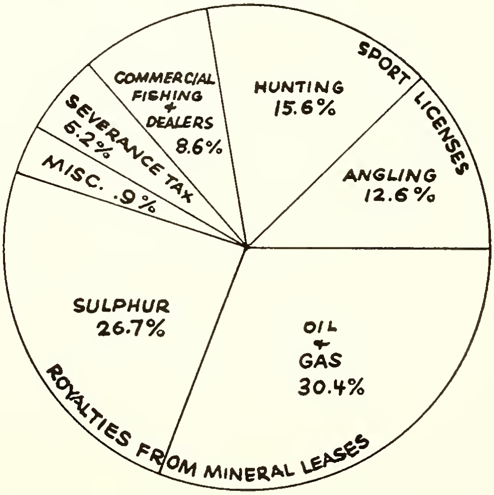


EXHIBIT 2

OPERATING ACCOUNT BY DIVISION

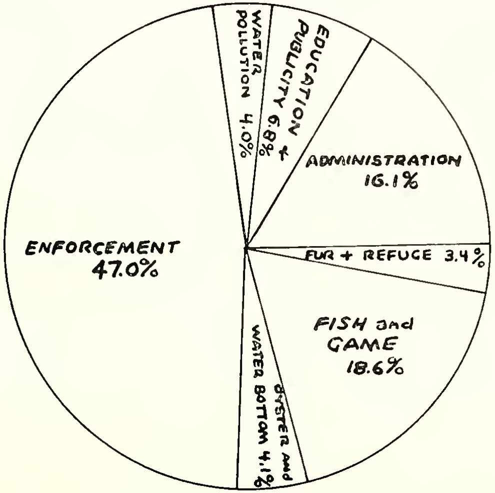
Actual Expenses for the Fiscal Year 1956-1957

Class of Expenditures	Administration	Education & Publicity	Water Pollution	Enforcement	Oyster & Water Bottoms	Fish & Game	Fur & Refuge	Total Operating
Salaries	121,521.97	44,654.57	48,502.98	618,701.34	48,357.50	210,398.31	15,744.47	1,137,881.14
Contractual Services	98,247.10	64,321.58	2,473.90	11,875.12	6,307.24	15,810.68	2,127.64	201,314.66
Traveling Expenses	8,415.67	1,249.56	6,535.33	157,173.45	2,080.86	30,530.10	3,666.60	209,651.57
Material and Supplies	15,031.81	5,403.29	7,108.79	87,067.80	18,661.04	99,768.09	12,114.24	245,003.66
Special Current Charges	68,953.49	....	....	....	....	....	....	68,953.49
Equipmnt—Capital Outlay	1,408.57	15,379.84	77,216.16	36,103.15	4,939.10	4,600.67	1,515.12	76,541.61
Total Expenditures	313,578.61	131,008.84	77,216.16	910,920.86	80,345.74	361,107.85	65,168.07	1,939,346.13

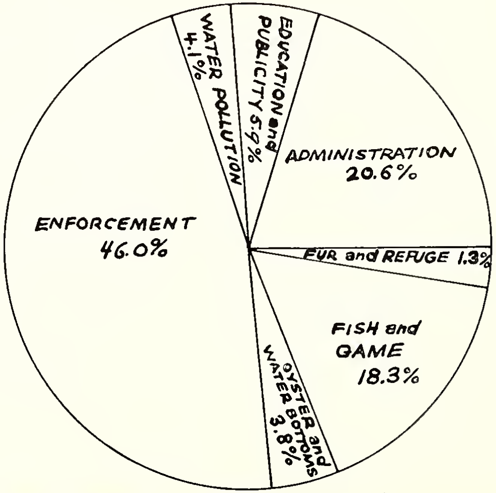
Estimated Expenses for the Fiscal Year 1957-1958

Class of Expenditures	Administration	Education & Publicity	Water Pollution	Enforcement	Oyster & Water Bottoms	Fish & Game	Fur & Refuge	Total Operating
Salaries	202,008.00	49,900.00	63,179.00	632,253.00	50,253.00	243,444.00	15,270.00	1,256,307.00
Contractual Services	88,437.00	57,756.00	2,226.00	1,687.00	5,651.00	14,229.00	1,914.00	180,900.00
Traveling Expenses	14,400.00	1,200.00	7,200.00	176,000.00	6,000.00	38,400.09	1,200.00	244,400.00
Material & Supplies	7,515.00	2,701.00	3,554.00	43,533.00	9,330.00	48,231.00	6,057.00	120,921.00
Special Current Charges	76,965.00	....	....	....	....	....	....	76,965.00
Equipment—Capital Outlay	1,000.00	1,000.00	1,000.00	10,000.00	1,000.00	3,000.00	1,000.00	18,000.00
Total Expenditures	390,325.00	112,557.00	77,159.00	872,473.00	72,234.00	347,304.00	25,441.00	1,897,493.00

Note: The total insurance premiums, retirement contributions, hospitalization and life insurance premiums, and social security for the operating divisions are included in Administration.



Actual Distribution of Expenses for the Fiscal Year 1956-1957



Estimated Distribution of Expenses for the Fiscal Year 1957-1958

EXHIBIT 3

PITTMAN-ROBERTSON ACCOUNT

Means of Financing:	Actual 1956-57	Estimated 1957-58
Balance of Federal Apportionment	$307,985.55	$391,960.02
Federal Apportionment	268,480.05	278,978.51
	576,465.60	670,938.53
Federal's Share of Expenditures	184,505.58	259,386.00
Federal Balance	391,960.02	411,552.53
State Allotment	70,000.00	85,000.00
State's Share of Expenditures	64,417.76	86,462.00
Due State Treasurer	5,582.24	(1,462.00)
Analysis Of Expenditures:		
Management coordination —the administration and supervision by technically trained personnel of all Federal Aid Projects	17,726.99	33,457.00
Investigation of wildlife to promote sound management practices	90,846.95	123,533.00
Development & operation of game management areas to increase the game species	135,392.97	176,758.00
Investigational Publication of wildlife inventory and management plan	....	12,100.00
A statistical survey of Game and Fish harvest and management data	4,956.43	....
TOTAL EXPENDITURES	$248,923.34	$345,848.00

EXHIBIT 4

DINGELL-JOHNSON ACCOUNT

Means of Financing:	Actual 1956-57	Estimated 1957-58
Balance of Federal Apportionment	$ 28,995.73	$ 31,371.45
Federal Apportionment	62,360.98	55,967.79
	91,356.71	87,339.24
Federal's Share of Expenditures	59,985.26	76,200.05
Federal Balance	31,371.45	11,139.19
State Allotment	40,000.00	25,000.00
State's Share of Expenditures	20,976.62	25,400.03
Due State Treasurer	19,023.38	(400.03)
Analysis of Expenditures:		
Management coordination —the administration and supervision by technically trained personnel of all Federal Aid Projects	7,129.85	10,490.53
An evaluation of Commercial Gear	15,034.16	23,164.70
Fish Population Investigation	35,491.79	37,243.15
Fish Population to Aquatic Conditions in Polluted Waters	20,001.79	23,001.00
Ecological survey of Factors to establish what habitats are rich, average or poor in production of fish food organisms	....	7,700.70
A statistical survey of Game & Fish harvest and management data	3,304.29	....
TOTAL EXPENDITURES	$ 80,961.88	$101,600.08

EXHIBIT 5

OYSTER SEED GROUND ACCOUNT

Used for the planting, propogation, cultivating, policing, preservation and distribution of oysters

Means of Financing:	Actual 1956-57	Estimated 1957-58
Fund Balance at end of Prior Fiscal Year	$183,866.93	$302,117.10
Add Revenues	316,120.43	330,000.00
	499,987.36	632,117.10
Less Expenditures	197,870.26	172,232.60
Fund Balance at end of Fiscal Year	302,117.10	459,884.50
Analysis of Expenditures:		
Salaries	80,051.07	80,422.89
Contractual Services	15,651.67	34,802.00
Traveling Expenses	8,104.85	8,205.40
Materials & Supplies	49,191.97	39,076.90
Special Current Charges	4,742.78	4,370.88
Equipment—Capital Outlay	40,127.92	5,354.53
	197,870.26	172,232.60

EXHIBIT 6

COMMERCIAL SEAFOOD ACCOUNT

Used to administer and enforce the commercial seafood laws

Means of Financing:	Actual 1956-57	Estimated 1957-58
Fund Balance at end of Prior Fiscal Year	$182,194.50	$391,893.43
Add Revenues	319,012.62	330,000.00
	501,207.12	721,893.43
Less Expenditures	109,313.69	204,242.91
Fund Balance at end of Fiscal Year	391,893.43	517,650.52
Analysis of Expenditures:		
Salaries	70,628.22	82,056.43
Contractual Services	4,125.52	40,994.58
Traveling Expenses	10,385.84	16,859.34
Materials & Supplies	14,461.36	18,338.40
Special Current Charges	3,649.23	3,355.66
Equipment—Capital Outlay	6,063.52	10,291.90
Construction	....	32,346.60
	109,313.69	204,242.91

Dedicated Revenue as set forth in Act 533 of 1950, Section 458. This tax collected on shells taken from State owned water bottom is divided equally between Oyster Seed GroundAccount and Commercial Seafood Account.

EXHIBIT 7

ROCKEFELLER REFUGE ACCOUNT

Means of Financing:	Actual 1956-57	Estimated 1957-58
Prior year's Balance	96.13	2,227.86
State Appropriation for Rockefeller Fund	75,000.00	691,200.00
Insurance claims for storm damage, etc.	....	77,845.49
Fur Sales, Sale of equipment, etc.	2,726.37	....
	77,822.50	771,273.35
Less: Expenditures	75,594.64	603,521.12
End of year's Balance	2,227.86	167,752.23
Analysis of Expenditures:		
Salaries	48,761.79	65,922.04
Contractual Services	10,651.49	50,258.62
Traveling Expenses	2,333.53	4,706.80
Material & Supplies	10,000.13	57,685.85
Special Current Charges	2,047.45	3,100.16
Equipment—Capital Outlay	....	96,847.65
Construction	1,800.25	325,000.00
Total Expenditures	75,594.64	603,521.12

EXHIBIT 8

MARSH ISLAND AND STATE WILDLIFE ACCOUNT

Means of Financing:	Actual 1956-57	Estimated 1957-58
Prior year's Balance	5,153.56	195,162.01
Drawn from Marsh Island Fund	221,800.00	....
Insurance claims for storm damage, etc.	....	67,072.70
Fur Sales, Pasturage, etc.	28,675.55	....
	255,629.11	262,234.71
Less: Expenditures	60,467.10	202,996.85
End of year's Balance	195,162.01	59,237.86
Analysis of Expenditures:		
Salaries	36,232.98	49,299.89
Contractual Services	1,985.74	26,420.95
Traveling Expenses	2,713.56	4,893.06
Material & Supplies	17,221.48	21,838.94
Special Current Charges	1,142.36	3,464.68
Equipment—Capital Outlay	1,170.98	15,240.09
Construction	....	81,839.24
Total Expenditures	60,467.10	202,996.85

EXHIBIT 9

WATER HYACINTH CONTROL

Means of Financing:	Actual 1956-57	Estimated 1957-58
Special State Appropriations	250,000.00	250,000.00
Analysis of Expenditures:		
Salaries	114,495.47	173,850.00
Contractual Services	7,954.03	24,000.00
Traveling Expenses	3,805.65	2,400.00
Materials & Supplies	93,178.52	36,200.00
Special Current Charges	6,920.78	10,450.00
Equipment	22,746.75	3,100.00
Total Expenditures	249,101.20	250,000.00

Crew members of the Water Hyacinth Control Section of the Fish and Game division are shown applying chemicals to a badly choked Louisiana lake. Because of the efficient operation of this section, sportsmen find many more pleasant hours of fishing and cattlemen more water for their stock.

EXHIBIT 10

SPECIAL FUNDS

	Actual 1956-57	Estimated 1957-58
Seismic Fund:		
Balance beginning of year	200,665.13	285,232.24
Receipts	752,160.00	750,000.00
	952,825.13	1,035,232.24
Less: Expenditures	667,592.89	700,000.00
Balance end of year	285,232.24	335,232.24
Gulf States Marine Fisheries Commission:		
State Appropriation	7,500.00	7,500.00
Less: Expenditures	5,618.27	5,700.00
Due State Treasurer	1,881.73	1,800.00
To Advertise & Promote Fur Industry:		
State Appropriation	50,000.00	25,000.00
Less: Expenditures	— 0 —	— 0 —
Due State Treasurer	50,000.00	— 0 —
Ducks Unlimited:		
State Appropriation	60,000.00	60,000.00
Less Expenditures	60,000.00	60,000.00
Due State Treasurer	— 0 —	— 0 —
Building Fund Act 3 of '57:		
Purchase of Civil Courts Building	....	1,100,000.00
Building Fund Act 21 of 55 (General Fund):		
Furniture & Fixtures	200,000.00	199,044.15
Expenditures	955.85	199,044.15
Balance	199,044.15	— 0 —

EXHIBIT 11

TOTAL BARRELS OF VARIOUS TYPES OF PROCESSED SHRIMP MARKETED DURING THE TEN YEARS FROM 1946-1955 AND TWO YEARS 1956 AND 1957 AND VALUE TO THE PRODUCER FOR 1956 AND 1957.

	Total 1946-1955	Average 1946-1955	1956	1957
Whole	527,236.5	52,723.7	48,304.1	21,111.4
Headless	1,996,658.3	199,665.8	194,087.9	119,683.7
Canned	880,763.7	88,076.4	50,916.9	26,011.4
Dried	372,956.0	37,295.6	15,742.6	8,926.2
Cooked & Peeled	217,534.5	21,753.5	9,078.8	5,328.4
	3,995,149.0	399,515.0	318,130.3	181,061.1
Estimated Value to Producer, 1956 - 1957			$20,675,000.00	$13,575,000.00

Exhibit 11 shows clearly the extreme decrease in shrimp production during the years 1956 and particularly 1957. The 1957 figure of 181,061 barrels is less than half the normal production in recent years and is the lowest on record since 1933.

EXHIBIT 12

MONTHLY SHRIMP PRODUCTION

	MONTHLY AVERAGE 1941-1942		MONTHLY PRODUCTION 1953-1957		
	Six Year Monthly Barrel Average 1941-1946	Six Year Monthly Barrel Average 1947-1952	Three Year Monthly Barrel Average 1953-1955	Monthly Total 1956	Monthly Total 1957
January	52,312	19,048	17,514	12,042.9	10,180.4
February	34,691	18,221	12,154	8,230.5	5,685.7
March	19,001	13,558	9,071	7,700.9	5,525.8
April	12,591	17,552	18,824	6,863.0	7,412.7
May	21,958	36,263	44,777	29,562.0	18,703.8
June	37,996	28,804	47,175	33,022.5	26,967.9
July	29,907	11,847	31,395	25,457.3	21,743.8
August	19,603	45,479	46,101	37,017.1	18,537.0
September	60,210	47,835	48,865	28,636.1	21,101.4
October	66,999	61,076	61,769	54,820.0	20,662.5
November	74,775	44,559	48,220	39,358.7	13,736.5
December	68,312	34,998	32,312	35,419.3	10,803.6
TOTALS	498,355	379,240	418,177	318,130.3	181,061.1

Exhibit 12 shows the monthly shrimp production for 1956 and 1957 as compared with several averaged prior periods. It is interesting to note that the decrease for each of these years is spread fairly evenly over the entire year instead of being concentrated in any particular period of the year.

SHRIMP BOATS

EXHIBIT 13

SHRIMP PRODUCTION PROCESSED IN EACH AREA FOR THE YEAR 1956

1956 Area Production	Whole	Headless	Canned	Dried	Cooked & Peeled	Total Bbls.	Per Cent 1956
La. Shrimp Processed in Other Gulf States	358.9		18,872.0			19,230.9	6.1
French Market	19,312.3					19,312.3	6.1
N. O. Area, St. Bernard and Plaquemines Parish	4,403.8	21,409.8	6,931.6	3,230.3		35,975.5	11.3
Lafourche Parish	15,656.6	38,874.0				54,530.6	17.1
Terrebonne Parish	998.9	28,136.0	20,679.2	11,394.7	9,078.8	70,287.6	22.1
Jefferson Parish	6,743.4	57,009.8	2,703.1	1,117.6		67,573.9	21.2
St. Mary and all other parishes to Texas line	830.2	48,658.3	1,731.0			51,219.5	16.1
Total Production	48,304.1	194,087.9	50,916.9	15,742.6	9,078.8	318,130.3	100%

EXHIBIT 14

SHRIMP PROCESSED IN EACH AREA FOR THE YEAR 1957

1957 Area Production	Whole	Headless	Canned	Dried	Cooked & Peeled	Total Bbls.	Per Cent 1957
La Shrimp Processed in Other Gulf States	201.5		12,397.7			12,599.2	7.0
French Market	6,726.1					6,726.1	3.7
N. O. Area, St. Bernard and Plaquemines Parish	1,160.9	6,777.8	2,433.0	985.0		11,356.7	6.3
Lafourche Parish	8,747.3	28,320.6				37,067.9	20.5
Terrebonne Parish	211.9	25,015.5	10,520.7	7,450.7	5,328.4	48,527.2	26.8
Jefferson Parish	3,722.1	32,802.6	660.0	490.5		37,675.2	20.7
St. Mary and all other parishes to Texas line	341.6	26,767.2				27,108.8	15.0
Total Production	21,111.4	119,683.7	26,011.4	8,926.2	5,328.4	181,061.1	100%

Exhibits 13 and 14 show how the shrimp processing industry is concentrated along the Louisiana coast. It is reasonable to assume that the percentage of shrimp caught in each area is dircetly proportional to the shrimp processed in each area since most trawl boat operators sell their catch locally. Therefore, it is possible to determine relative changes in the shrimp catch among the areas from year to year. Only a small amount of Louisiana shrimp are taken out of the state to be processed.

EXHIBIT 15

SHRIMP PRODUCTION AND NUMBER OF TRAWLS AND/OR SEINES

Calendar Year	No. Barrels Shrimp (210 lbs.)	No. of Seines	No. of Trawls
1913	50,000	131	....
1914	52,381	131	....
1915	57,143	268	....
1916	85,714	......	....
1917	57,143	......	....
1918	71,429	300	17
1919	76,190	......	....
1920	152,381	97	499
1921	163,012	135	983
1922	109,050	111	699
1923	153,749	128	1,021
1924	150,624	143	905
1925	154,722	180	1,010
1926	123,967	143	692
1927	150,896	120	913
1928	195,303	261	1,454
1929	210,033	125	1,486
1930	197,550	172	1,176
1931	178,815	126	1,131
1932	152,373	66	699
1933	166,058	67	1,045
1934	226,576	107	1,441
1935	252,981	125	1,433
1936	286,749	30	1,920
1937	362,942	35	2,313
1938	363,656	13	1,662
1939	395,050	26	1,621
1940	397,189	5	3,016
1941	554,354	5	3,028
1942	489,173	4	2,380
1943	441,445	4	2,101
1944	544,378	4	1,866
1945	495,994	4	2,373
1946	464,981	4	3,030
1947	365,617	4	3,408
1948	376,605	4	3,200
1949	376,040	4	3,310
1950	361,365	3	2,819
1951	396,980	0	2,248
1952	398,952	0	2,277
1953	437,340	10	3,543
1954	451,647	4	3,442
1955	365,542	5	3,276
1956	318,130	7	3,072
1957	181,061	9	2,419

Exhibit 15 is a historic record of the shrimp industry in Louisiana since 1913. Naturally the number of trawls in operation tends to vary from year to year depending on the pre-season prospects from year to year.

EXHIBIT 16

NUMBER OF RESIDENT AND NON-RESIDENT TRAWL BOATS BY PARISH AND STATE FOR 1956

Parish	20 Feet and Under	Over 20 Feet thru 35 Feet Incl.	Over 35 Feet thru 45 Feet Incl.	Over 45 Feet	Total
Acadia	....	2	3	2	7
Allen	1	....	....	....	1
Assumption	....	....	1	....	1
Calcasieu	75	25	18	3	121
Cameron	8	29	22	2	61
Iberia	....	29	22	8	59
Jefferson Davis	2	2	3	....	7
Jefferson	37	323	99	25	484
Lafayette	2	1	1	....	4
Lafourche	5	57	100	75	237
Livingston	....	4	....	....	4
Orleans	29	139	47	14	229
Plaquemines	4	88	55	6	153
St. Bernard	4	59	47	5	115
St. Charles	4	18	12	....	34
St. John	3	2	....	....	5
St. Landry	....	1	....	....	1
St. Mary	10	26	32	104	172
St. Tammany	2	16	5	5	28
Tangipahoa	5	22	....	....	27
Terrebonne	29	237	286	64	616
Vermilion	27	58	26	32	143
Washington	1	....	....	....	1
Total Louisiana	248	1,138	779	345	2,510

State	20 Feet and Under	Over 20 Feet thru 35 Feet Incl.	Over 35 Feet thru 45 Feet Incl.	Over 45 Feet	Total
Alabama	....	....	17	22	39
Florida	....	....	....	2	2
Mississippi	1	67	83	192	343
Texas	129	18	19	12	178
Total Non-Resident	130	85	119	228	562

EXHIBIT 17

NUMBER OF RESIDENT AND NON-RESIDENT TRAWL BOATS BY PARISH AND STATE FOR 1957

Parish	20 Feet and Under	Over 20 Feet thru 35 Feet Incl.	Over 35 Feet thru 45 Feet Incl.	Over 45 Feet	Total
Acadia		1	2	1	4
Allen	1	....	....	....	1
Assumption		1	1	....	2
Calcasieu	15	18	4	4	41
Cameron	4	12	18	1	35
Iberia	....	23	16	....	39
Iberville	....	1	1	....	2
Jefferson	18	212	66	36	332
Jefferson Davis	1	3	3	....	7
Lafayette	2	1	1	....	4
Lafourche	5	31	59	32	127
Orleans	33	104	48	10	195
Plaquemines	7	56	45	13	121
St. Bernard	5	50	24	12	91
St. Charles	1	10	16	....	27
St. John	11	1	....	....	12
St. Landry	1	....	....	....	1
St. Martin	1	....	....	....	1
St. Mary	3	12	49	83	147
St. Tammany	....	8	2	9	19
Tangipahoa	....	9	....	....	9
Terrebonne	17	181	284	65	547
Vermilion	28	16	16	16	76
Total Louisiana	153	750	655	282	1,840

State	20 Feet and Under	Over 20 Feet thru 35 Feet Incl.	Over 35 Feet thru 45 Feet Incl.	Over 45 Feet	Total
Alabama	....	....	2	5	7
Florida	....	....	....	4	4
Mississippi	1	64	119	229	413
Texas	113	28	5	9	155
Total Non-Resident	114	92	126	247	579

Exhibits 16 and 17 present the number of trawl boats in operation for the years 1956 and 1957 respectively. These figures are presented by parish for Louisiana and state for non-resident boats. Also the distribution by boat size categories is presented. This type of information is used extensively in our shrimp research programs.

EXHIBIT 18

MENHADEN PRODUCTION BY UNITS

One Unit = 666 Pounds (Approximately 1,000 Fish)

	TOTAL UNIT PRODUCTION Louisiana, Mississippi, Texas			Louisiana Unit Production		
Company	2 Year Average 1954-1955	1956	1957	2 Year Average 1954-1955	1956	1957
Louisiana:						
Empire Menhaden Co.	133,241	142,356	95,825	133,241	142,356	95,825
La. Menhaden Co.	93,056	114,115	37,879	93,056	114,115	37,879
Gulf Menhaden Co.	121,141	134,000	45,000	121,141	134,000	45,000
The Quinn Menhaden Fisheries	81,807	86,000	57,934	81,807	86,000	57,934
TOTAL	429,245	476,471	236,638	429,245	476,471	236,638
Mississippi:						
Miss. Menhaden Products	....	37,000	36,000	....	14,800	14,400
Offshore Menhaden Co.	....	8,500	20,000	....	5,100	12,000
Fish Meal Co.	75,479	100,000	104,185	75,479	80,000	46,883
Wallace M. Quinn Fisheries	40,268	46,507	18,000	37,233	19,533	7,200
Standard Products Co.	22,477	40,924	33,925	22,477	20,462	16,962
TOTAL	138,224	232,931	212,110	135,189	139,895	97,445
Texas:						
Port Arthur Menhaden Products	41,416	86,639	60,633	28,698	25,992	12,127
Quinn Menhaden Fisheries	31,502	12,884	25,500	27,168	3,865	19,125
TOTAL	72,918	99,523	86,133	55,866	29,857	31,252
GRAND TOTAL	640,387	808,925	534,881	620,300	646,223	365,335

Exhibits 18 through 20 present the operations of the menhaden industry in Louisiana for the past four years. The unit production figures are actual as submitted by each company, but the yield and evaluation figures for the Louisiana production are averaged and do not necessarily represent the actual yield or income for any one company.

The menhaden fleet operating in Louisiana waters consists of about eighty (80) vessels, which average slightly over 100 feet each. The crew of each vessel consists of between twenty (20) and twenty-five (25) men and the average pay of $3.60 for each unit produced.

As evidenced by Exhibit 19, the menhaden product consists of oil, meal and solubles. The oil has multiple uses, some of which are the base for linoleum, paint and soap, tempering metals and for various vitamin compounds. The dried meal is the pulverized scrap remaining after the oil has been removed and is used in manufacturing feeds for farm animals and poultry. The water from the separating tanks is processed into a thick paste called solubles and is used as an additive to commercial fertilizers and poultry feeds.

The production decrease in 1957 was due primarily to "Hurricane Audrey", which occurred at the height of the menhaden season.

EXHIBIT 19

ESTIMATED YIELD—LOUISIANA MENHADEN PRODUCTION

	Gals. Oil at an Average of 9.5 Gals. per Unit		Tons Meal at an Average of .07 Tons per Unit		Tons Solubles at an Average of .04 Tons per Unit	
	1956	1957	1956	1957	1956	1957
La. Companies	4,526,475	2,248,061	33,353	16,565	19,059	9,466
Miss. Companies	1,329,003	925,728	9,793	6,821	5,596	3,898
Texas Companies	283,642	296,894	2,090	2,188	1,194	1,250
TOTAL	6,139,120	3,470,683	45,236	25,574	25,849	14,614

EXHIBIT 20

ESTIMATED PROCESSED VALUE—LOUISIANA MENHADEN PRODUCTION

	Oil Value at an Average of $.63 per Gal.		Meal Value at an Average of $128.00 per Ton		Solubles Value at an Average of $75.00 per Ton		Estimated Total Value Oil, Meal & Solubles	
	1956	1957	1956	1957	1956	1957	1956	1957
La. Companies	$2,851,679	$1,416,278	$4,269,184	$2,120,320	$1,429,425	$ 709,950	$ 8,550,288	$4,246,548
Miss. Companies	837,272	583,209	1,253,504	873,088	419,700	292,350	2,510,476	1,748,647
Texas Companies	178,694	187,043	267,520	280,064	89,550	93,750	535,764	560,857
TOTAL	$3,867,645	$2,186,530	$5,790,208	$3,273,472	$1,938,675	$1,096,050	$11,596,528	$6,556.052

The following open letter was submitted by a representative of two plants located in Louisiana:

February 27, 1958

Louisiana Wild Life and Fisheries Commission
126 Civil Courts Building
New Orleans 16, Louisiana

Gentlemen:

We appreciate the interest you have taken in the menhaden industry by inviting us to submit information on our operations for publication in the Seventh Biennial Report of the Wildlife and Fisheries Commission.

The Wallace Menhaden Products Company is allied with the operations of two plants in Louisiana, situated at Empire and Cameron. These are the Empire Menhaden Company and the Louisiana Menhaden Company.

Because the general public knows so little about the methods employed in catching and processing menhaden and the uses to which menhaden products are put, we are sending you a copy of a brochure published by the Menhaden Information Council which describes the industry in detail.

Adverse weather conditions during 1957 were largely responsible for the enormous production deficiency suffered not only by the Empire and Louisiana Menhaden Companies but also by the other two companies operating in Louisiana waters.

Production in Cameron also suffered greatly due to the effects of Hurricane Audrey which caused extensive damage to the Louisiana Menhaden Company plant. More than 20 of the plant employees or members of their families perished in the storm. Fortunately, the plant was able to make emergency repairs and resume production several weeks after the hurricane and is now capable of normal production.

It is our opinion that production will return to its normal level in 1958 and subsequent years, provided weather conditions are favorable.

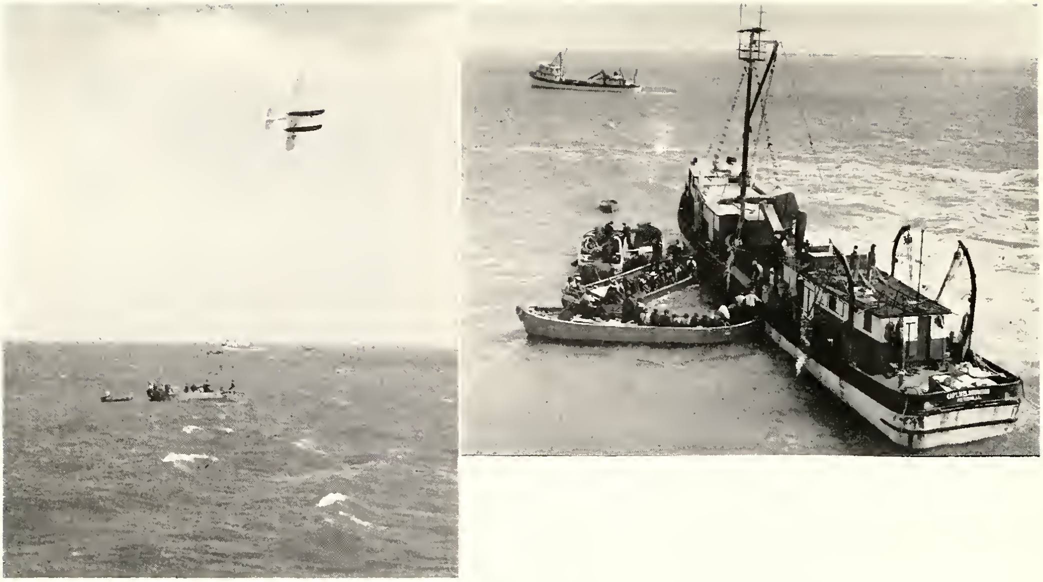
It has been the observation of many veterans in this industry that menhaden are obviously un-affected by fishing and are able to replenish their populations year after year. This has been particularly true along the Atlantic seaboard where some menhaden plants have been operating without let-up for almost 50 years. Today, the catches being brought into these plants are bigger than ever.

Thank you again for giving us an opportunity to submit this report.

Yours very truly,

WALLACE MENHADEN COMPANY
Jack T. Styron,
Secretary

JTS/rh



These pictures by Paul Kalman show crew boats as they lay their large nets around a school of menhaden located by a spotter plane. The menhaden vessel stands by for the catch, which is removed by a large vacuum suction pump. After separation from the water sucked up with the catch, the fish are blown into the ship's hold through a chute.

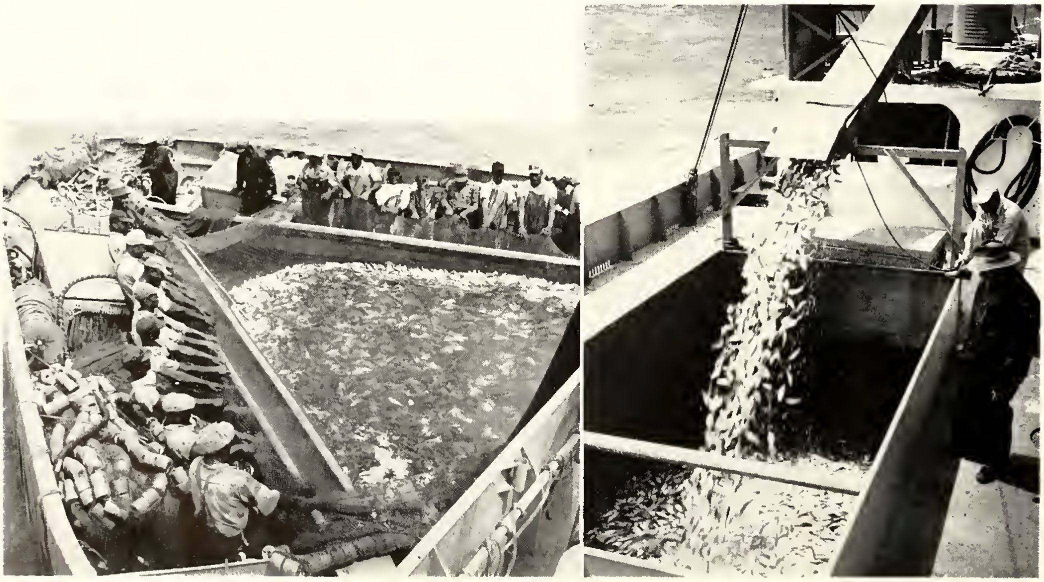


EXHIBIT 21

COMPARATIVE STATEMENT OF FRESH AND SALT WATER COMMERCIAL FISH PRODUCED BY LOUISIANA FISHERMEN

July 1st, 1955—June 30th, 1956 with July 1st, 1956—June 30th, 1957

	July 1, 1955 - June 30, 1956		July 1, 1956 - June 30, 1957	
Fresh Water Fisheries	**Pounds**	**Value**	**Pounds**	**Value**
Catfish	7,068,412	$2,474,000.00	5,090,840	$1,781,800.00
Gaspergou	1,702,551	255,500.00	1,034,592	155,200.00
Spoonbill	90,746	18,150.00	188,211	37,600.00
Buffalo	2,417,351	483,500.00	2,636,908	527,400.00
Garfish	483,933	58,000.00	714,148	85,700.00
Common Fish	477,440	23,800.00	229,992	11,500.00
River Shrimp	1,248	600.00	4,307	2,100.00
Fresh Water Turtles	118,441	35,500.00	138,776	41,600.00
Crayfish	1,293,693	323,000.00	1,205,436	301,400.00
Frogs	81,404	32,500.00	141,664	56,700.00
TOTAL	13,735,219	$3,704,550.00	11,384,874	$3,001,000.00
Salt Water Fisheries				
Sea Turtles	9,068	2,700.00	9,359	2,800.00
Speckled Trout	605,683	181,500.00	623,837	187,150.00
Red Fish	344,863	70,000.00	279,496	55,900.00
Sheephead	69,364	7,000.00	97,359	9,700.00
Flounders	207,122	41,500.00	272,653	54,500.00
Red Snappers	89,637	22,000.00	49,003	12,200.00
Mullet	342,081	51,500.00	364,194	54,600.00
Drum	262,924	26,000.00	368,137	36,800.00
Miscellaneous	258,455	25,500.00	234,230	23,400.00
Hard Shell Crabs	6,552,675	330,000.00	7,603,367	380,200.00
Soft Shell Crabs	249,200	75,000.00	908,440	272,500.00
Crab Meat	401,733	321,500.00	504,920	403,900.00
TOTAL	9,392,805	$1,154,200.00	11,314,995	$1,493,650.00
Baby Green Turtles	Number 1,800,006	180,000.00	Number 1,497,472	149,750.00
TOTAL FRESH AND SALT WATER FISHERIES	23,128,024	$5,038,750.00	22,699,869	$4,644,400.00

Exhibit 21 is a comparison of the various species of fresh and salt water fish produced by Louisiana fishermen for the fiscal years ended June 30, 1956 and June 30, 1957. Except for the relatively small catfish yield in the latter year, both periods were normal as compared with recent prior years.

EXHIBIT 22

STATEMENT OF LICENSES SOLD BY PARISHES FOR THE YEAR 1956

EXPLANATION OF NUMBERED COLUMNS

Column Number	Type of Licenses
1	Commercial Fresh Water Hoop Nets (15 nets allowed to operate under each license)
2	Commercial Fresh Water Fish Seines
3	Commercial Fish Producer
4	Commercial Fresh Water Trammel Nets
5	Commercial Fresh Water Fish Gill Nets
5-A	Salt Water Trammel Nets and Seines
6	Wholesale Dealer
7	Wholesale Dealer's Agent
8	Retail Dealer

Parish	1	2	3	4	5	5-A	Total Netting	Per Cent Each Par.	6	7	8	Total
Acadia	18	11	28	8	21	1	87	.012	2	3	22	114
Allen	24	0	1	8	1	0	34	.005	0	0	36	70
Ascension	27	0	10	1	4	0	42	.006	5	5	24	76
Assumption	24	1	188	2	34	0	249	.035	8	9	17	283
Avoyelles	74	15	33	12	98	0	232	.033	5	1	52	290
Beauregard	15	1	13	1	20	0	50	.007	2	0	21	73
Bienville	10	2	11	32	46	0	101	.014	0	0	12	113
Bossier	11	0	14	19	76	0	120	.017	1	0	24	145
Caddo	55	6	65	47	115	0	288	.041	9	0	91	388
Calcasieu	41	5	76	8	46	14	190	.027	3	0	148	341
Caldwell	18	1	16	11	18	0	64	.009	0	0	2	66
Cameron	1	0	15	1	3	8	28	.004	3	0	2	33
Catahoula	83	10	16	11	54	0	174	.025	5	4	5	188
Claiborne	1	0	1	0	0	0	2	.000	0	0	17	19
Concordia	43	5	17	8	23	0	96	.014	1	0	5	102
DeSoto	16	3	17	2	28	0	66	.009	0	0	15	81
East Baton Rouge	32	1	18	8	31	2	92	.013	6	0	210	308
East Carroll	23	2	24	22	73	0	144	.020	4	0	5	153
East Feliciana	1	0	0	0	7	0	8	.001	0	0	9	17
Evangeline	33	3	17	19	7	1	80	.011	0	0	21	101
Franklin	42	11	12	11	106	0	182	.026	2	0	4	188
Grant	11	2	17	5	36	0	71	.010	0	0	8	79
Iberia	21	1	14	0	16	5	57	.008	5	1	16	79
Iberville	226	2	43	12	1	1	285	.039	11	4	9	309
Jackson	0	0	4	0	7	0	11	.002	0	0	13	24
Jefferson	0	2	46	3	2	12	65	.009	33	3	173	274
Jefferson Davis	30	7	71	5	43	2	158	.022	4	0	26	188
Lafayette	7	6	7	2	4	0	26	.004	1	0	43	70
Lafourche	2	1	76	1	1	0	81	.011	27	5	40	153
LaSalle	48	2	9	54	55	1	169	.024	0	0	8	177
Lincoln	2	0	1	0	0	0	3	.000	0	0	6	9
Livingston	21	0	17	1	19	0	58	.008	0	0	28	86

Madison	18	6	3	13	24	0	64	.009	0	0	11	75
Morehouse	34	5	13	24	45	0	121	.017	1	0	25	147
Natchitoches	24	5	26	19	134	0	208	.029	0	0	30	238
Orleans	4	2	89	1	6	42	144	.020	72	10	957	1,183
Ouachita	79	4	33	39	75	0	230	.032	1	1	20	252
Plaquemines	3	0	13	0	1	11	28	.004	4	3	5	40
Pointe Coupee	17	6	25	4	25	0	77	.011	1	0	19	97
Rapides	49	3	30	43	135	0	260	.037	5	0	144	409
Red River	9	0	9	2	26	0	46	.007	0	0	9	55
Richland	19	2	11	7	103	0	142	.020	0	0	16	158
Sabine	17	1	22	5	24	0	69	.010	0	0	11	80
St. Bernard	0	0	15	2	0	3	20	.003	6	2	12	40
St. Charles	3	0	81	0	5	0	89	.013	0	2	12	103
St. Helena	3	0	0	0	2	0	5	.001	0	0	0	5
St. James	2	0	10	0	4	0	16	.002	1	1	21	39
St. John	5	0	9	0	6	0	20	.003	0	0	30	50
St. Landry	115	15	82	24	46	0	282	.040	4	1	50	337
St. Martin	117	0	129	3	42	0	291	.041	2	8	35	336
St. Mary	183	8	348	8	28	7	582	.081	20	10	91	703
St. Tammany	13	0	116	0	2	24	155	.022	2	0	52	209
Tangipahoa	14	0	37	7	11	1	70	.010	6	1	92	169
Tensas	15	1	6	17	167	0	206	.029	1	1	1	209
Terrebonne	1	1	24	1	6	21	54	.008	67	6	81	208
Union	44	0	5	25	25	0	99	.014	0	0	11	110
Vermilion	12	2	16	1	4	9	44	.006	2	0	22	68
Vernon	3	0	19	5	14	1	42	.006	1	0	26	69
Washington	22	0	12	0	4	0	38	.005	5	0	35	78
Webster	24	0	14	6	117	0	161	.023	0	0	21	182
West Baton Rouge	12	1	5	0	8	0	26	.004	0	0	4	30
West Carroll	31	1	10	7	103	0	152	.021	0	0	2	154
West Feliciana	8	0	0	1	2	0	11	.002	0	0	8	19
Winn	7	0	9	2	11	0	29	.004	0	0	9	38
TOTALS	1,867	163	2,118	580	2,200	166	7,094	100%	338	81	2,974	10,487

EXHIBIT 23

STATEMENT OF LICENSES SOLD BY PARISHES FOR THE YEAR 1957

EXPLANATION OF NUMBERED COLUMNS

Column Number	Type of Licenses
1	Commercial Fresh Water Hoop Nets (15 nets allowed to operate under each license)
2	Commercial Fresh Water Fish Seines
3	Commercial Fish Producer
4	Commercial Fresh Water Trammel Nets
5	Commercial Fresh Water Fish Gill Nets
5-A	Salt Water Trammel Nets and Seines
6	Wholesale Dealer
7	Wholesale Dealer's Agent
8	Retail Dealer

Parish	1	2	3	4	5	5-A	Total Netting	Per Cent Each Par.	6	8	7	Total
Acadia	24	10	22	4	37	0	97	.016	3	2	33	135
Allen	21	0	3	7	10	0	41	.007	0	0	20	61
Ascension	14	0	2	1	3	0	20	.003	3	4	10	37
Assumption	42	0	3	2	10	0	57	.009	6	8	23	94
Avoyelles	71	11	26	10	134	0	252	.040	6	1	61	309
Beauregard	23	0	16	0	29	0	68	.011	1	0	24	93
Bienville	17	0	18	27	38	0	100	.017	1	0	32	133
Bossier	8	0	15	3	52	0	78	.013	1	0	20	99
Caddo	52	6	77	63	117	0	315	.052	12	0	83	410
Calcasieu	52	13	52	9	84	16	226	.037	4	0	143	373
Caldwell	18	0	13	15	27	0	73	.012	0	0	4	77
Cameron	0	1	13	1	8	7	30	.005	1	0	2	33
Catahoula	56	10	12	12	33	0	123	.020	5	4	2	134
Claiborne	1	0	1	0	9	0	11	.002	0	0	8	19
Concordia	25	0	12	5	44	0	86	.014	1	0	6	93
DeSoto	20	2	13	1	42	0	78	.013	0	0	14	92
East Baton Rouge	41	5	17	6	36	0	105	.017	7	0	113	225
East Carroll	17	2	23	13	75	0	130	.022	3	0	16	149
East Feliciana	0	0	0	0	4	0	4	.001	0	0	4	8
Evangeline	63	4	15	17	38	0	137	.023	0	0	32	169
Franklin	60	7	6	25	59	0	157	.026	3	0	6	166
Grant	14	0	15	11	41	0	81	.013	0	0	9	90
Iberia	22	0	2	2	2	2	30	.005	1	1	33	65
Iberville	216	0	2	5	2	0	225	.037	10	6	10	251
Jackson	0	0	1	0	4	0	5	.001	0	0	15	20
Jefferson	2	0	6	0	2	10	20	.003	37	2	142	201
Jefferson Davis	29	5	37	8	22	1	102	.017	3	0	39	144
Lafayette	10	4	15	2	8	0	39	.007	2	0	47	88
Lafourche	2	0	4	0	0	4	10	.002	22	5	34	71
LaSalle	44	2	6	27	31	0	110	.018	2	1	13	126
Lincoln	2	0	1	0	1	0	4	.001	0	0	9	13
Livingston	21	0	13	0	9	0	43	.007	0	0	24	67

Madison	13	0	4	13	20	0	50	.008	0	0	13	63
Morehouse	38	1	14	20	44	0	117	.019	1	0	24	142
Natchitoches	27	2	21	105	157	0	312	.052	0	0	25	337
Orleans	5	3	86	0	30	12	176	.029	48	3	892	1,119
Ouachita	61	5	37	40	77	0	220	.037	4	0	70	294
Plaquemines	1	0	14	0	0	12	27	.005	4	3	10	44
Pointe Coupee	24	5	27	7	29	0	92	.015	1	1	24	118
Rapides	58	3	24	32	131	0	248	.041	4	0	115	367
Red River	11	0	4	25	31	0	71	.012	0	0	20	91
Richland	20	3	13	13	66	0	115	.019	0	0	21	136
Sabine	13	0	19	4	22	0	58	.010	0	0	8	66
St. Bernard	0	0	13	0	0	6	19	.003	6	8	24	57
St. Charles	2	1	8	0	0	1	12	.002	1	2	13	28
St. Helena	1	0	0	2	0	0	3	.001	0	0	0	3
St. James	1	0	0	0	2	0	3	.001	1	2	12	18
St. John	2	0	0	0	18	0	20	.003	0	0	18	38
St. Landry	80	23	56	31	83	0	273	.045	3	1	88	365
St. Martin	114	0	60	4	44	0	222	.037	4	7	44	277
St. Mary	195	5	33	21	51	8	313	.052	18	8	71	410
St. Tammany	9	0	54	1	1	13	78	.013	2	0	57	137
Tangipahoa	11	0	10	1	16	0	38	.006	2	0	74	114
Tensas	19	1	6	23	63	0	112	.019	1	0	2	115
Terrebonne	1	0	5	1	0	24	31	.005	63	11	50	155
Union	46	0	6	32	24	0	108	.018	1	0	9	118
Vermilion	12	2	5	2	10	6	37	.006	8	0	21	66
Vernon	5	0	23	0	12	0	40	.007	0	0	24	64
Washington	18	0	13	2	5	0	38	.006	2	0	46	86
Webster	24	0	5	6	99	0	134	.022	0	0	34	168
West Baton Rouge	1	0	3	0	3	0	7	.001	0	0	7	14
West Carroll	29	1	9	11	111	0	161	.027	1	0	12	174
West Feliciana	4	0	0	2	2	0	8	.001	0	0	5	13
Winn	14	0	9	5	15	0	43	.007	0	0	22	65
TOTALS	1,846	137	1,042	679	2,177	162	6,043	100%	309	80	2,886	9,307

Exhibits 22 and 23 give the number of net licenses and dealer licenses sold in each parish for the years 1956 and 1957. The percent column may be used to determine the relative position of each parish as compared with any or all of the others.

EXHIBIT 24

COMPARATIVE TAKES OF FUR ANIMALS IN LOUISIANA

1953-1954 Season

	Number of Pelts Per Year	Average Price at Point of Severance	Approx. Value of Skins to Producer
Muskrat	1,173,209	@ .80	$ 938,567.20
Nutria	160,654	@ 2.00	321,308.00
Mink	58,706	@ 8.50	499,001.00
Raccoon	49,857	@ .50	24,928.50
Opossum	6,344	@ .25	1,586.00
Otter	3,884	@ 13.00	50,492.00
Skunk	311	@ .25	77.75
Fox	86	@ .25	21.50
Cat	5	@ .25	1.25
TOTAL	1,453,056		$1,835,983.20

1954-1955 Season

	Number of Pelts Per Year	Average Price at Point of Severance	Approx. Value of Skins to Producer
Muskrat	1,383,114	@ 1.10	$1,521,425.40
Nutria	374,199	@ 2.05	767,107.95
Mink	65,170	@ 15.00	977,550.00
Raccoon	84,223	@ .75	63,167.25
Opossum	7,497	@ .35	2,623.95
Otter	5,407	@ 16.00	86,512.00
Skunk	120	@ .50	60.00
Fox	31	@ .50	15.50
Cat	542	@ .40	216.80
TOTAL	1,920,303		$3,418,678.85

1955-1956 Season

	Number of Pelts Per Year	Average Price at Point of Severance	Approx. Value of Skins to Producer
Muskrat	1,821,840	@ .80	$1,457,472.00
Mink	57,142	@ 11.00	628,562.00
Raccoon	61,520	@ .90	55,368.00
Otter	4,653	@ 18.00	83,754.00
Nutria	418,772	@ 1.00	418,772.00
Opossum	6,211	@ .15	931.65
Fox	185	@ .25	46.25
Skunk	273	@ .20	54.60
Cat	102	@ .25	25.50
TOTAL	2,370,698		$2,644,986.00

1956-1957 Season

	Number of Pelts Per Year	Average Price at Point of Severance	Approx. Value of Skins to Producer
Muskrat	1,589,433	@ .80	$1,271,546.40
Mink	62,872	@ 7.00	440,104.00
Raccoon	72,522	@ 1.00	72,522.00
Otter	5,261	@ 16.00	84,176.00
Nutria	543,160	@ 1.50	814,740.00
Opossum	5,056	@ .15	758.40
Fox	76	@ .25	19.00
Skunk	526	@ .20	105.20
Cat	31	@ .25	7.75
Miscellaneous	2	@ .25	.50
TOTAL	2,278,939		$2,683,979.25

EXHIBIT 25

NUMBER OF FUR LICENSES SOLD

Season	1953-54	1954-55	1955-56	1956-57
Resident Fur Buyer	163	147	134	133
Resident Fur Dealer	27	21	20	21
Non-Res. Fur Buyer	1	1	0	0
Non-Res. Fur Dealer	1	1	2	2
Trapper	4,986	5,202	5,520	4,260

Exhibits 24 and 25 give a brief picture of the fur industry in Louisiana over the past four seasons. Although the total take has increased slightly during the past two years, this has been offset by a declining average price paid for pelts.

The Fur Division section of this report will give complete details of what is being done to promote the fur industry in Louisiana.

Restocking Beaver in North Louisiana.

EXHIBIT 26

NUMBER OF HUNTING LICENSES SOLD

SEASON 1939-1940 TO 1956-1957, INCLUSIVE

Season	Total Licenses	Hunting Resident $1.00	Hunting Non-Resident $25.00	Hunting Non-Resident 4-Day Trip $5.00
1939-40	98,167	93,587	1,335	3,245
1940-41	116,653	115,336	166	1,151
1941-42	146,648	144,349	495	1,804
1942-43	119,543	118,300	163	1,080
1943-44	94,609	93,334	181	1,094
1944-45	124,485	121,767	407	2,311
1945-46	162,872	160,795	409	1,681
1946-47	170,396	169,652	744	*.......
1947-48	176,715	175,482	1,233	*.......
1948-49	222,201	221,702	499	*.......
1949-50	235,447	234,964	483	1,140
1950-51	235,472	234,195	137	1,140
1951-52	235,855	234,177	192	1,486
1952-53	209,665	207,428	169	2,068
1953-54	251,488	248,496	**2,992	**.......
1954-55	242,456	239,695	**2,761	**.......
1955-56	246,731	243,756	2,975	**.......
1956-57	287,810	284,844	2,966	**.......

NOTE: * No trip licenses issued during these years.

** Non-Resident sold on a reciprocal basis beginning with the 1953-54 season. These licenses include both season and trip.

EXHIBIT 27

NUMBER OF ANGLING LICENSES SOLD

YEARS 1939-1956, INCLUSIVE

Year	Total	Angling Resident $1.00	Angling Non-Resident $5.00	Angling Non-Resident 7-Day Trip $2.00
1939	27,096	12,649	14,447	**.......
1940	31,014	16,140	14,874	**.......
1941	52,695	38,080	*14,615	....
1942	41,661	30,608	*11,053	....
1943	36,112	29,492	3,332	3,288
1944	33,239	25,755	3,743	3,741
1945	35,002	27,000	4,088	3,914
1946	52,909	42,621	5,808	4,480
1947	64,055	59,353	4,702	**.......
1948	66,797	63,657	3,140	**.......
1949	82,942	72,397	5,970	4,575
1950	83,068	72,044	5,872	5,152
1951	89,337	76,516	6,477	6,344
1952	102,715	89,159	6,207	7,349
1953	205,049	178,994	10,087	15,968
1954	217,282	187,832	12,048	17,402
1955	220,835	187,466	13,917	19,452
1956	218,757	186,106	14,817	17,834

NOTE: * Includes both annual and 7-day trip. ** No 7-day trip licenses issued during these years.

Allowing $200.00 for each licensed fisherman and hunter the estimated value of sport equipment is as follows:

Angling Equipment	$ 43,751,400.00
Hunting Equipment	57,562,000.00
TOTAL VALUE	$101,313,400.00

Exhibits 26 and 27 give running comparisons of the number of sport licenses sold over an eighteen (18) year period. The number of all classes of licenses sold have been steady during the last four years with no unusual increases or decreases.

The evaluation of angling and hunting equipment in use is based on the number of paid licenses and is probably low considering the number of sportsmen who are exempt from the purchase of hunting and/or angling licenses in Louisiana.

Those exempt from the purchase of sport licenses are as follows:

1. All resident women may apply for free permanent angling licenses. This law was passed in 1956 and had little, if any, effect on the number of angling licenses sold to women during 1956, since most anglers purchase their licenses early in the year.
2. All resident persons who have reached their sixtieth birthday and have actually resided within the state for two years prior to application, are issued free permanent permits to hunt and fish.
3. All persons on active military duty are exempt from the purchase of sport licenses.
4. All persons under sixteen years of age are exempt from the purchase of sport licenses.
5. No resident is required to have an angling license unless a reel or artiificial bait is used.

EXHIBIT 28

LICENSES SOLD BY PARISHES

	1956 ANGLING			1956-57 HUNTING		1956-57 TRAPPING
PARISH	Res. $1.00	N.R. 7 Day Trip $2.00	Non-Res. $5.00	Res. $1.00	Non-Res. Reciprocal	Res. Only $2.00
Acadia	1514	8	2	5526	14	26
Allen	1402	21	8	3750	17	60
Ascension	1351	15	2	2795	0	60
Assumption	260	1	2	1568	2	122
Avoyelles	1660	290	74	5140	4	49
Beauregard	1005	91	41	2923	9	44
Bienville	551	86	14	2093	2	22
Bossier	2836	807	223	3320	0	32
Caddo	16088	6057	5060	15915	78	125
Calcasieu	11381	859	3489	15374	1022	110
Caldwell	415	16	3	1358	2	38
Cameron	923	52	52	1465	253	145
Catahoula	527	249	61	2119	27	29
Claiborne	850	47	53	1890	4	32
Concordia	1189	992	2503	3213	176	12
DeSoto	894	108	113	2420	17	53
East Baton Rouge	17005	100	47	18406	12	28
East Carroll	548	223	139	1935	34	47
East Feliciana	308	1	3	1525	0	16
Evangeline	1187	187	35	4075	0	32
Franklin	891	38	14	3787	15	36
Grant	852	152	6	2292	9	36
Iberia	3013	29	3	5232	13	57
Iberville	1093	5	3	2439	0	30
Jackson	1221	59	7	2485	8	29
Jefferson	9605	0	0	9459	14	129
Jefferson Davis	1879	67	14	4359	89	132
Lafayette	3105	21	4	6788	36	6
Lafourche	2290	2	1	6067	0	196
LaSalle	1233	223	61	2724	7	15
Lincoln	1015	21	7	2435	5	20
Livingston	2102	120	77	4143	0	70
Madison	517	77	111	2061	75	58
Morehouse	1932	34	22	5433	11	71
Natchitoches	3035	3840	730	4512	61	63
Orleans	37996	289	205	15795	316	160
Ouachita	5839	229	29	11708	25	60
Plaquemine	702	0	0	1897	13	99
Pointe Coupee	1104	200	22	2379	1	8
Rapides	5652	232	31	11287	29	65
Red River	396	146	83	1249	6	32
Richland	1103	28	11	3876	5	78
Sabine	624	22	12	2674	6	24
St. Bernard	1906	0	0	1296	0	100
St. Charles	2101	5	4	2400	0	64
St. Helena	122	7	10	792	4	15
St. James	553	2	0	1602	0	77
St. John	467	3	1	1178	0	59
St. Landry	3874	64	21	9736	15	46
St. Martin	524	0	1	2609	1	60
St. Mary	2536	83	5	5123	36	240
St. Tammany	5355	147	219	4309	36	67
Tangipahoa	3311	116	162	6768	8	89
Tensas	396	292	155	1856	52	32
Terrebonne	3536	22	4	6098	13	329
Union	511	46	65	2499	19	33
Vermilion	1496	8	6	5320	309	237
Vernon	1138	155	110	3069	6	46
Washington	2589	30	190	5782	11	47
Webster	3383	464	366	4674	12	58
West Baton Rouge	1486	1	2	1460	1	7
West Carroll	509	62	8	2603	19	49

EXHIBIT 28 (CONT'D.)
LICENSES SOLD BY PARISHES

PARISH	1956 ANGLNG Res. $1.00	N.R. 7 Day Trip $2.00	Non-Res. $5.00	1956-57 HUNTING Res. $1.00	Non-Res. Reciprocal	1956-57 TRAPPING Res. Only $2.00
West Feliciana	154	2	0	991	1	5
Winn	1066	281	111	2788	6	44
TOTAL SOLD	186106	17834	14817	284844	2966	4260
TOTAL SOLD 1955 & 1955-56	187466	19452	13917	243756	2975	5520
Increase	....	....	900	41088	....	....
Decrease	1360	1618	....	....	9	1260
% Increase	....	....	6.5%	16.9%	....	....
% Decrease	.7%	8.3%	....	....	.03%	22.8%

Exhibit 28 is prepared each year as soon as returns for these classes of licenses are complete. Each sheriff handles the distribution, collection and remittance from the sale of these licenses in his respective parish with the exception of Orleans Parish where these functions are carried out by our main office. It is a simple matter to compare each parish with the others to see how it ranks in sports activities.

EXHIBIT 29
CIVIL FEES FOR LAW VIOLATIONS

Fees Collected and Transmitted to the Following Parish School Boards For The Fiscal Years	1955-56	1956-57
Acadia Parish	$ 287.50	$ 662.50
Allen Parish	525.50	137.50
Ascension Parish	50.00	4,850.00
Assumption Parish	200.00	162.50
Avoyelles Parish	1,010.82	2,043.68
Beauregard Parish	62.50	100.00
Bienville Parish	800.00	149.75
Bossier Parish	1,225.00	350.00
Caddo Parish	2,535.00	565.00
Calcasieu Parish	1,189.00	1,487.50
Caldwell Parish	225.00	175.00
Cameron Parish	287.50	425.00
Catahoula Parish	152.50	25.00
Claiborne Parish	698.50	141.00
Concordia Parish	137.50	125.00
DeSoto Parish	825.00	262.50
East Baton Rouge Parish	— 0 —	975.00
East Feliciana Parish	74.47	174.75
Evangeline Parish	272.50	535.00
Franklin Parish	275.00	75.00
Grant Parish	597.94	236.94
Iberia Parish	587.50	862.50
Iberville Parish	199.55	270.90
Jackson Parish	365.00	100.00
Jefferson Parish	900.00	762.50
Jefferson Davis Parish	490.00	115.00
Lafayette Parish	475.00	682.50
Lafourche Parish	850.00	760.00
LaSalle Parish	112.50	212.50
Lincoln Parish	202.50	25.00
Livingston Parish	998.45	1,099.40
Morehouse Parish	52.50	50.00
Natchitoches Parish	554.35	836.40
Ouachita Parish	37.50	837.50
Plaquemine Parish	— 0 —	425.00
Pointe Coupee Parish	387.50	575.00
Rapides Parish	625.00	1,200.00
Red River Parish	275.00	50.00
Richland Parish	— 0 —	722.50
Sabine Parish	112.50	170.00
St. Bernard Parish	60.00	575.00
St. Charles Parish	837.50	74.72
St. Helena Parish	125.00	175.00
St. James Parish	437.50	100.00
St. John the Baptist Parish	300.00	175.00
St. Landry Parish	999.75	852.25
St. Martin Parish	275.00	862.50
St. Mary Parish	462.50	926.50
St. Tammany Parish	2,962.50	950.00
Tangipahoa Parish	748.72	645.00
Terrebonne Parish	437.50	537.50
Union Parish	314.72	320.00
Vermilion Parish	787.50	200.00
Vernon Parish	550.00	162.50
Washington Parish	725.00	275.00
Webster Parish	837.50	67.50
West Baton Rouge Parish	112.50	87.50
West Carroll Parish	25.00	40.00
West Feliciana Parish	112.50	237.50
Winn Parish	312.50	50.00
	$30,079.27	$30,728.79

Exhibit 29 shows the amounts remitted to us in fines for law violations for the two fiscal years ended June 30, 1956 and June 30, 1957.

Each parish school board is transmitted the amount collected in that particular parish, therefore, all cases made are for conservation purposes only, rather than for additional revenues to be applied to our own operations.

THE WHARF

CLAUDE LE BLANC
Superintendent

CLAUDE LeBLANC

Known as the "Wharf" the marine and radio repair department of the commission, which comes under the Administrative section, is located on the New Basin canal at 7612 West End Boulevard.

All boats of the commission in need of major repairs return to the wharf or are transported by trailer where full machine radio repair and carpenter shop facilities are maintained and a crew of 19 men is on hand to effect rapid and efficient repairs under the direction of Claude LeBlanc, veteran boatbuilder and maintenance man.

Under LeBlanc, who was formally in charge of maintenance at Attu, in the Aleutian islands for the Army Transport service, during World War II, crews are sent out all over the state to effect on-the-spot repairs to outboard motor, inboard motor craft, trailers and radios when it is not necessary to return them to the wharf.

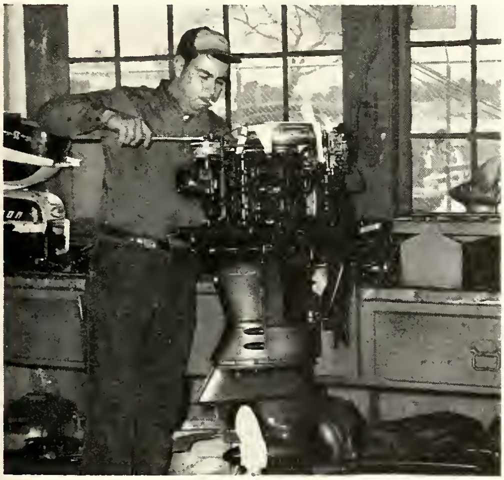
At the wharf proper, more than fifty major repairs on "haul outs" are effected annually and outboard repairs average two a day and small hull repairs average from 3 to 4 a week. The commission's 165 trailers are repaired in the field for the most part and the wharf also takes care of such repairs as refrigeration, the renovating and painting of boats and maintains a 10-ton hoist for dry docking boats. During the year it is the duty of LeBlanc and the 19 men of the wharf to see to it that the commission's 32 large craft, 146 small boats and 240 outboard motors are kept going in all parts of the state.

Besides boat repairs the wharf is charged with repairs to installations and boat houses at the various refuges, installation of radios in automobiles. All equipment at the commission's radio transmitting stations are installed by wharf crews. Following hurricane Audrey 11 men attached to the wharf were sent out by LeBlanc to effect immediate repairs to re-build storm torn buildings; all such extra curricular jobs are taken care of by the wharf's men.

Purchasing for the field such as marine supplies for boats, radios, supplies for camps, etc., are handled through the wharf. Constant communication by a fixed radio transmitter with remote control through the main office makes it possible to maintain constant communication with boats, planes and mobile units stationed throughout Louisiana. Besides the outboard, motor shop, marine repair shop and carpenter shop, the wharf maintains a warehouse for stock parts and materials.

Repairs to the Commission's statewide network of radio communications are effected at the WHARF. Left to right are, Repairman Forstner Wolbrecht and radio technician Robert Smothers.

THE WHARF is home port for disabled patrol boats, radios, outboard motors and trailers. Crews are sent out from here to various parts of the state to effect minor repairs.



The Commission's 250 outboard motors are kept in condition at the **WHARF**. Mechanic Ralph Paratore is seen above.

The **WHARF**, with its 24-hour standby radio communications, played an important part during Hurricane "Audrey".

AVIATION

SECTION

JOHN F. ELLINGTON

Chief Pilot

JOHN ELLINGTON

This report of the Aviation Section of the Louisiana Wild Life and Fisheries commission covers the period beginning January 1, 1956 and ending December 31, 1957, and outlines in detail the activities and improvements of this airborne group.

Originally this airborne group was established as another unit of the law enforcement division of the commission and later a part of the oysters and water bottoms division. Since that time this section's activities have so broadened that it is now operating as an advantageous adjunct to all divisions of the agency.

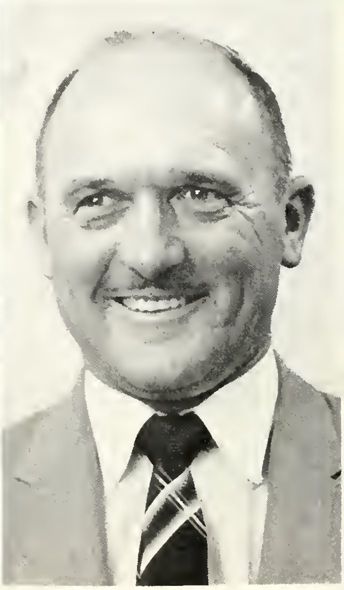
Approximately 50% of all flying is devoted solely to enforcement of the fish and game laws. For example, during the period June 21, 1957 to the second Monday in August, 1957, this section was responsible for 80% of all shrimp violation arrests made in the state. In this streamlined world flying game agents are not exactly a new thing, but the Louisiana Wild Life and Fisheries commission is finding its flying agents extremely valuable in the enforcement of the fish and game laws. And, the law violator has found that the approaching drone of an airplane motor is a forerunner of apprehension.

In the days before the airplane was put into use by the commission, fish and game violators played a merry game of tag with agents in the Louisiana bayous and marshes. Knowing the labyrinth of canals, bayous and lagoons as they knew the decks of their own boats, they had little difficulty in dodging the enforcement officer . . . but they don't dodge the radio equipped planes.

Ducking into shallow bayous or marshes, where the patrol

Pilot Nat Pedro

Chief Mechanic John F. McGovern



Pilot Preston "Buck" Davis

boats of the commission can't go, doesn't give them sanctuary either. A patrol plane pilot can spot the violator, radio his location and direct boat borne officers to him, if necessary. Or, if the water or terrain is suitable for landing, the flying game agent can make the arrest himself.

"Flying Squadrons" of rangers are being employed with excellent results in all parts of the state. These units are sent out from headquarters in special squads wherever violations of considerable numbers are reported. Because they are not known in the areas into which they are rushed, they are able to avoid the identification which too many times warns the violator to get under cover, and in a few hours they have been known to entirely clean up communities where illegal hunting and fishing has been reported. The work of these squadrons is increasing daily and the effect is being felt throughout the entire state, with the result that much game and countless fish are being saved from illegal destruction.

The remaining 50% of flying is devoted to all other divisions of the commission such as assisting in the work of making biological tests, transporting scientists and providing them an opportunity to study from the air certain conditions and formations that would be far less discernible from land or water surfaces; assisting the Division of Education and Publicity in the taking of aerial photography; speedy transportation for outdoor writers and photographers for publications of national scope; transportation for commission personnel when speedy arrival at a given destination is essential in behalf of public relations, and the transportation of visiting writers on whom the Division of Education and Publicity must rely in publicizing Louisiana's wildlife resources; participating in the taking of game census, throughout the state, on game reservations and land open to public hunting; lending a vital service to individuals where rescue work is urgently needed before and after storms; aiding in the rescue of persons and valuable wildlife during floods; aiding in the search for lost persons, boat crews and land and water conveyance; being available at all times to aid in the search for drowned persons, for boats overdue at their home ports and all other types of emergency relief and rescue work.

For example, immediately following Hurricane Audrey, two Grumman Widgeons were immediately assigned to rescue work in the Cameron and Grand Chenier area. These airplanes flew from daylight to dark rescuing families from isolated areas. Approximately one hundred and fourteen people were rescued and brought to Lake Charles by our airplanes. All outboard motor boats of the commission were equipped with Walkie-Talkie radios and an airplane would locate people on logs, etc., and radio to the boats their location. Also the same method was used in retrieving the drowned people.

This section also gives assistance to various Federal agencies in their wildlife and conservation work in Louisiana as well as aids state agencies other than the Louisiana Wild Life and Fisheries commission; full cooperation with all divisions of the commission whenever and wherever an airplane is needed to make their work simple and more successful.

On July 1, 1957, all personnel of the aviation section was transferred from the different divisions and put under the aviation section's payroll. This in turn completed the consolidation of all operations and maintenance under an individual head, the Chief Pilot. This has greatly improved the service of this section and at the same time has provised a closer check on the cost of maintenance and operation of this unit. Daily reports are being kept showing in detail the daily cost of operation and maintenance and the actual expenses of the section has been decreased considerably in relation to service rendered in previous years.

Commencing in June, 1956, all equipment of the aviation section was renovated. For example, one of our Widgeons, N1629H was completely overhauled and converted to larger engines. This increased the safety factor of flying in this airplane 100%. Later in the year the commission saw fit to trade one of our old Widgeons (N75222), which was manufactured in 1941, in on a new Widgeon. Such a high trade-in was received that the difference between the two airplanes was negligible. The moneys used in this trade did not affect the budget in the least. A new converted 6-place Widgeon was had in place of a 1941 model plane.

Men who keep the plans in top shape at the Commission's hangar and in the air are, left to right, Assistant-Mechanic Melvin Patnett; Chief Mechanic John F. McGovern, and mechanics Courtney Bienvenue and Oscar F. Figueroa.

In the early part of 1947 the remaining Seabee became unoperative and not feasible to be repaired. This airplane was turned over to the Division of Administration for sale. The commission received within a few hundred dollars what was paid originally for the plane. This plane was replaced by a Cessna 180 on amphibian floats. So at the present the aviation section has two Super Widgeons and one Cessna 180.

This section also has its own hanger at the New Orleans Airport with a completely equipped machine and repair shop capable of doing any sort of repair or renovation work needed to keep the flying equipment in A-1 condition. I may add, that by having our own maintenance shop, the cost of operation is approximately 50% of what it would be if all work were contracted out.

An amphibian ramp was constructed at Pass-a-Loutre camp in October 1956. This enabled our airplanes to taxi out of the water for the purpose of re-fueling, unloading supplies, in case of bad weather to remain overnight, and in case of emergency, repairs may be effected.

The personnel of the aviation section consists of the Chief Pilot and two other fully accredited pilots, each of long experience in aviation; three licensed aircraft and engine me-

Inside of Commission's storage and repair hangar at New Orleans airport.

chanics, one mechanic's helper, and one stockroom clerk and a clerk-typist. Detail reports of the work done by each of these individuals, as well as the cost of maintenance of the section, are submitted semi-monthly to the Director of the commission.

During the last few years considerable and favorable publicity has been given this aviation section of the Wild Life and Fisheries commission by several leading magazines. One publication, in particular, The Saturday Evening Post, singled out this unit as the outstanding one of its kind in the United States and carries a most colorful account of the activities of Louisiana flying game agents along with pictorial matter showing how they "got the job done".

That the aviation section has become one of the important cogs in the machinery of the entire Wild Life and Fisheries commission is unquestioned. Aside from its value as a law enforcement unit, the speed with which this air service can get division personnel to distant points means a great saving in time and money. Trips that would take eight to ten hours by automobile or boat may be made in an hour or less by airplane. The speed with which the world moves today must be matched if we are to keep pace.

One of the Super Grumman Widgeons used for patrol and Commission business.

This Cessna 180 on amphibious floats has excellent maneuverability and is an arm of the Commission's air patrol.

EDUCATION AND PUBLICITY DIVISION

MEL WASHBURN

Chief

MEL WASHBURN

The Division of Education and Publicity is one of many facets. Its major obligation is the dissemination of education with regard to the conservation of Louisiana's natural wildlife resources. To fulfill this obligation every medium must be employed. Thus it is necessary that the personnel of this division must be thoroughly conversant with the activities of all other divisions of the Louisiana Wild Life and Fisheries commission.

No one medium could possibly be used exclusively for the promotion of a true spirit of conservation for the enlightenment of the general public to the needs for the preservation and protection of the state's fish, game, and wildlife habitat.

First of all, this division must serve as a clearing house for all types of information sought by individuals, organizations, civic clubs, schools, bureaus and institutions of various kinds. By answering these queries we are able to acquaint Louisianians with the status of this commission's current activities and plans for the future welfare of our natural wildlife resources.

Because it is becoming more and more evident that a favorable public sentiment is being created throughout the state with respect to our own Wild Life and Fisheries, the general absorption of education concerning conservation can be generally attributed to the public relations contacts that this office develops. These contacts are found in many fields.

EDNARD WALDO
Staff Assistant

W. C. GOINS
Staff Assistant

STEVE HARMON
Editor

EDOUARD MORGAN
Museum Supervisor

In recent years, television has become a major medium for the dissemination of some of our most successful education. Radio, newspapers, periodicals, including nationally popular magazines and publications, dedicated to fishing and hunting, commercial fisheries, and supplies attendant to these publications, are all used by this division whenever possible. To profit by the use of media such as these, this division must not only provide written material but factual data, brochures, photographs and motion pictures developed and produced by this division.

In addition, this division must originate all news releases eminating in the commission, all directives from the Director and the various division heads, as well as specialized material for outdoor writers, newspaper columnists and contributors to national magazines which cover a fishing and hunting field.

The division's major effort for education in conservation is the publication of the LOUISIANA CONSERVATIONIST, a monthly magazine, that now goes to more than 53,000 in the state and nation. This magazine, originated in 1948, carries the messages of our biologists, game management experts, scientists and division executives to the lay public preaching the need of conservation, the advantages of modern game and fish management, the warnings of encroachment that endangers our wildlife resources and the programs that must be devised and developed if our wildlife is to survive in the abundance necessary to continue our natural heritage.

As the purpose of this publication primarily is the dissemination of education for better conservation, it is highly desirable that every bona fide resident of this state become better acquainted with Louisiana's needs for wildlife protection. Since its inception, the LOUISIANA CONSERVATIONIST has grown in popularity and prestige until it now ranks with the best in the nation.

In addition to publishing the LOUISIANA CONSERVATIONIST, this division must also publish a biennial report to the Legislature. This report, in book form, is not only for the enlightenment of the state legislators, but is compiled so that it is used in all the state's schools and libraries as a source of factual data on wildlife and its management.

For the last three years this division has originated a 15-minute radio program weekly that goes to 15 radio stations throughout the state. These programs are packaged, on tape, and sent to the various radio stations for use as their weekly outdoor program.

The television medium is being employed throughout the state for both entertainment and education with regard to our wildlife and fisheries. Whenever possible, personnel of this division has been used in television programs or in securing movies, live exhibits, still pictures and personalities. Through these efforts both radio and television have been utilized most successfully.

There is a steadily increasing demand from outdoor writers for national magazines for information on Louisiana's fabulous fishing and hunting and this material must be provided whenever sought. It is through these demands that this division has been able to bring Louisiana's conservation message before the national reading public and to acquaint the sportsmen of the nation with Louisiana's potentialities for their enjoyment of sports afield and astream.

At the present time, we have in preparation a publication listing and describing the hundreds of excellent fishing localities for both fresh and salt water anglers. We have recently completed brochures on Louisiana shrimp, Louisiana oysters, and the nutria. These brochures are in addition to others on snakes, spiders, crabs and frogs.

At the present time, this division maintains a film library with approximately 50 films on the various phases of wildlife for exhibition on request to schools, civic clubs, sportsmen's clubs, and boy and girl scout troups.

The Wild Life and Fisheries museum, in the Presbytere opposite Jackson Square in New Orleans, largest state museum of its kind in the country, is a part of this division. In this museum are approximately 3,000 individual exhibits of wildlife and fish. These exhibits are constantly being added to by a technical staff to develop and arrange background to simulate the natural hibitat of specimens on display.

In this museum also is a movie theatre with a seating capacity of more than 300, where motion pictures are shown free, almost daily, to school classes, civic clubs and organizations and others. With transient, or others belonging, to the city or state, it is estimated that more than 15,000 persons visit this museum each month of the year.

Another important part of our educational program is the building and maintenance of wildlife exhibits that may be shown throughout the state. These have become in constantly increasing demand by convention groups, clubs, fairs, and kindred assemblies. These public exhibits have done much to bring the conservation message directly to the people in various sections of the state as each individual exhibit is arranged with regard to conditions that prevail where it is to be shown.

When the Louisiana Wild Life and Fisheries commission takes complete occupation of its recently purchased domicile in the Civil Courts building, in New Orleans, one of the major plans if for the installation of a new, modern and greatly enhanced wildelife museum in this building. Looking forward to the time when this new museum becomes a reality, new exhibits are being designed, each in a setting

CALVIN BLACKWELL
Photographer

Specimens of mounted ducks simulating birds in flight as they are shown in the wild water fowl room in the wild life museum of the Louisiana Wild Life and Fisheries Commission in the Presbytere in New Orleans.

of its own simulated habitat, and an effort is being made to have at least one specimen of every known member of the state's wildlife family.

To carry on this division's efforts to supply the demand for pictures of all kinds, for its own publications as well as the demand from outsiders, this division now maintains a complete and modern photographic studio for the processing and printing of its own pictures and employs, as a regular staff member, a capable photographer and technician.

In addition to satisfying the demands of publications, television, radio, etc., this division has done considerable work among youth groups such as 4H clubs, boy and girl scout organizations, school classes throughout the state, lecturing and showing movies with a conservation message. Members of the personnel staff have assisted in arranging displays, conducting classes, organizing new clubs and providing them with suitable material to carry on their conservation work.

In the adult field, speakers have attended meetings of civic groups, wildlife clubs, conventions and sundry assemblies to further educate the public on the activities of the Wild Life and Fisheries commission. In this activity alone, hundreds of meetings are attended each year bringing the public in closer contact with conservation work.

Another obligation of this division is to prepare speeches for delivery by others representing the commission.

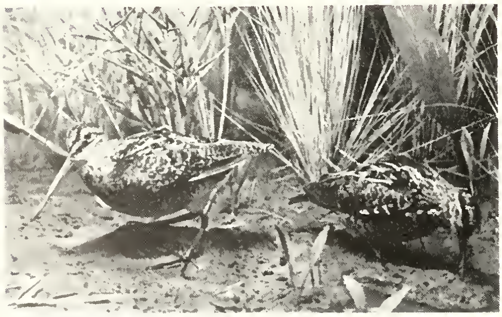
To carry on its daily work, this division maintains three station wagons, and one sedan for transportation; has the use of the commission's airplanes and boats when needed; has four motion picture projectors for the showing of movies at all kinds of meetings; and, three movie cameras for the making of movies.

The personnel staff of this division consists of the Chief, who is also publisher of the LOUISIANA CONSERVATIONIST; the editor of this magazine; two writers who assist in preparing magazine material, special wildlife features and news releases; two secretaries; one taxidermist and technician and his assistant who build exhibits and backgrounds; a librarian for the film library; a receptionist; a photographer; and a museum maintenance man. All members of this staff have been indoctrinated in wildlife conservation work and enthusiastically dedicate themselves to better education and public relations for the future of Louisiana's natural wildlife resources. They, at all times, work in close harmony with all other divisions of this commission, in keeping the general public informed of our conservation efforts and assisting in the development of programs for the future betterment of our wildlife and fisheries.

A beautiful specimen of Louisiana wild turkey which was mounted in typical wild turkey habitat by Edouard Morgan, museum technician, and now on display in the state wild life museum.

These two white pelicans are beginning their trip to the Court of St. James in England to replace two of the Louisiana birds that died.

An unusual mounting of a Louisiana bobcat on exhibit in the state wild life museum in New Orleans.



A pair of woodcocks shown in simulated surroundings in the Wild Life Museum.

Mrs. Earl K. Long, wife of the Governor, prepares a seafood salad preparatory to the opening of National Seafood Week.

FUR DIVISION

TED O'NEIL

Chief

TED O'NEIL

THE Fur Division is responsible for the promotion and development of the state's fur industry and the conservation of the state's fur-bearing animals.

Besides an extensive public relations program which calls for the maintaining of contacts with field representatives, dealers, fur buyers, trappers and others interested in the fur industry, the Fur division is also charged with the carrying out of the commission's program for improvement and conservation through planning various projects and enforcement of the laws concerning the fur industry of our state.

General administrative direction with respect to programs is under the Director but the Chief of the Fur division is responsible for the developing of the projects, procedures and techniques necessary to produce the desired results.

This department is a separate entity from the Refuge division, with which it works in close cooperation, in that its work is primarily concerned with conducting biological research, public relations work and for making recommendations concerning fur growing and marketing practices. The Refuge division, on the other hand is responsible for the statewide planning, operation and maintenance of all state owned wildlife refuges with particular emphasis on the protection, promotion and development of the refuges.

The Fur division plans, directs and coordinates statewide projects and initiates all field assignments and reveiws all reports relative to research, promotion and prepares articles for publication. Besides this, its job is to keep in direct touch with all those interested in the fur industry from the trapper in the marshes to the fur buyer. Also to supervise surveys of trapping lands throughout the state and formulate and submit recommendations concerning laws pertaining to trapping seasons and the commercial fur industry and prepare reports on the division's activities.

One of the most important operations of the Fur division was the re-stocking of the Marsh Island refuge with muskrats to re-populate that area which had been wiped out by Hurricane Audrey on June 27, 1957.

The re-stocking, which was done in conjunction with the Refuge division, will not only prove beneficial both in a dollar-and-cents value to the state but it will also be the source of much biological value to scientists since it will be possible through this re-stocking to observe and chart the increase of a muskrat population from its first beginning on a marsh which affords ideal conditions.

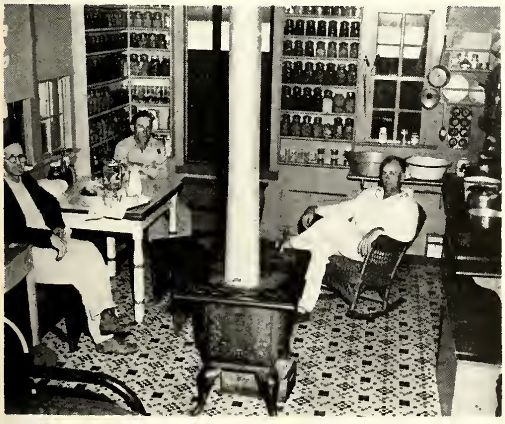
The refuge, which embraces 76,000 acres of marshlands along the coast of Vermilion and Cameron parishes, has produced more than 3,103,803 muskrats over two decades and is considered one of the most valuable fur producing areas in Louisiana and its re-stocking will restore, in time, a valuable revenue to the state.

From the point of view of biologists the area will be ideal for observation since as far as is known the refuge was swept clean of muskrats by the hurricane and the newly planted muskrat colonies will be starting from "scratch", so to speak.

After the storm the only large live animals seen in the area were about 40 nutria which had survived the hurricane by taking refuge in the old Bird Island refuge headquarters camp. A further search of the island refuge for fur-bearing animals after the storm brought reports of only occasional mink tracks, coon tracks and a good number of otter tracks.

No live muskrats were seen and only two live deer were reported in the area.

Because of the heavy silt left by the waters of the storm, which has enriched the island, stands of three-cornered grass have sprouted up in greater abundance than have been seen in many years and this grass is prime for muskrats and



This trapper camp in the Louisiana marshland is well stocked with farm-produced foods.

conditions are excellent both from a re-stocking and scientific observation point of view.

So far, the Fur division has released 400 of the animals which were gathered from good stock from other areas and placed in the finest habitat on the island. The commission's men are keeping an almost daily watch on the progress of the animals in their new homes and if the experiment is successful similar operations may be carried out in other areas such as the Rockefeller and State Wildlife refuge which also suffered depopulation from the storm.

Although the rats were not banded, they were kept together in families as taken from the other areas and placed in environments on the island superior to the terrain from which they were transported. About two-thirds of the rats were females and about 80% of these were carrying young.

Reason for not banding the rats was that it has been found from previous bandings that the rats become nervous and have a tendency to wander far away from the areas where they were released and it was thought better to forego the banding in order to assure their staying in the areas where they were placed so that a close observation could be made and it was also reasonable to assume that since there were no other muskrats on the island the figure garnered as to the progress of the new colonies would be fairly accurate.

It is expected that if the re-stocking is successful the muskrat population on the island might possibly be brought up to 50,000 in two years and it is possible that within the next three or four years trappers may be able to return and trap the normal excess population as was done heretofore.

Posed here is a typical Southwest Louisiana fur harvesting family.

During the past two decades the state, alone, has derived $1,405,175.46 in revenue from the Marsh Island refuge's fur take which includes, besides muskrat, mink, raccoon, otter and nutria. Total value to both the state and the trappers over that period has been $4,023,816.03.

In an effort to bolster the incentive of the trapper, the Fur division has conducted an extensive survey of markets for nutria meat which has resulted in the creation of a demand for practically every pound of the product that can be produced not only for human consumption but also for use in the finest dog and cat foods. An analysis of nutria prepared for human consumption made by the Agricultural Experimental station of Louisiana State University shows that nutria contins 71.5% protein, analyzed on a dry basis and 6.2% fat. Also because of its low fat bone content nutria is increasingly in demand not only for human consumption but also for the dog and cat food market both canned and frozen. Mink farmers who have tested the product have their bids in for as much of the meat as can be supplied them.

In the field of public relations the Fur division is called upon to meet many emergencies; as for instance, more than two years ago the trappers found themselves with 200,000 nutria pelts on hand as a certain surplus. The Fur division stepped in and after a number of conferences with fur buyers was able to have them take over the surplus with a final profit to both groups.

Living on the Cheniers throughout the coastal marshes was peaceful and comparatively simple when the cash crop of the year was fur-bearing animals.

The Fur division is constantly seeking to promote an American market for southern furs. The problem today is that practically all of the fur processing is done in Europe and the muskrats and nutria are for the most part consumed by the European market at pelt prices which seem fair in Europe yet are not high enough to meet the standards of living of the American trapper. This, of course, keeps the pelt prices down and if the American woman could be induced to use American furs through the proper advertising and promotion, the trapper could get the right prices for his pelts because the demand for them would be created.

Today practically all of the Louisiana furs are going to European markets and do not return after processing in any form. Europeans are conscious of the fine quality of Louisiana furs and there is a good market for them over there.

Today the American woman is mink conscious, whether it be ranch mink, wild domestic or imported mink, while the finest southern furs go wanting on our home market.

As has been pointed out before the problem confronting

This young trapper continues his 4-H Club activities by bringing the pig along to the trapping camp.

the trapper and fur buyer is the re-establishment of the American market for southern furs. Recently the Fur division sent an agent east to purchase a muskrat coat as an experiment and not one was to be had. The European market is consuming most of our present fur output, and this is practically on a month-to-month basis as concerns nutria furs. The problem that is of the moment is that muskrat and nutria production are on an increase and a market must be found for the impending surplus.

Before the "Mink Craze" the market had consumed as many as 10,000,000 Louisiana furs in a season. Today, the production which is governed by the demand, is down to around a little under three million furs of all kinds.

A tremendous vacuum for the impending over-production of southern furs could be created with the development of an American fur processing market. At present the Louisiana Wild Life and Fisheries commission through Director Clement is working with the Fur division and is lending every support to all those engaged in the industry to recreate the demand for Louisiana furs on our home market.

To put it briefly, in spite of the low prices, the European market is supporting our fur industry today. Without it, such as it is, the bottom would literally drop out for the Louisiana fur trapper. . . the domestic market must be re-established, for when this false economy goes, the Louisiana fur industry may be swept away.

Shown above are bins of muskrat pelts that were harvested from State Wildlife refuge.

Digging muskrats from their bank burrows in the Western Louisiana rice belt. These rats are to be used for restocking State refuges.

Here trappers, under the supervision of the Fur Division of the Louisiana Wild Life and Fisheries commission, release muskrat in suitable habitat on Marsh Island.

COMPARATIVE TAKES OF FUR ANIMALS IN LOUISIANA

			Approximate Price At Point of Severance	
	1940-1941 Season			
Muskrat	5,778,750	@	1.00	5,778,750.00
Mink	114,323	@	4.00	457,292.00
Raccoon	169,531	@	1.00	169,531.00
Opossum	131,045	@	.10	13,104.50
Otter	1,728	@	5.00	8,640.00
Skunk	15,499	@	.10	1,549.90
Fox	3,768	@	.50	1,884.00
Cat	227	@	.50	113.50
Miscellaneous	1,715	@	.50	857.50
Total	6,216,586			$6,431,722.40
	1941-1942 Season			
Muskrat	4,846,942	@	1.00	4,846,492.00
Mink	155,391	@	4.00	621,564.00
Raccoon	181,309	@	1.50	271,963.50
Opossum	128,027	@	.30	38,408.10
Otter	1,760	@	6.00	10,500.00
Skunk	20,880	@	.40	8,352.00
Fox	4,446	@	.50	2,223.00
Cat	399	@	.50	199.50
Miscellaneous	4,027	@	.50	2,013.50
Total	5,342,731			$5,801,775.60
	1942-1943 Season			
Muskrat	4,253,397	@	1.18	5,019,008.46
Mink	128,311	@	4.00	513,244.00
Raccoon	164,695	@	2.00	329,390.00
Opossum	78,738	@	.35	27,558.30
Otter	1,399	@	7.50	10,492.50
Skunk	17,349	@	.75	13,011.75
Fox	3,727	@	1.25	4,658.75
Cat	231	@	.15	34.65
Miscellaneous	48	@	.50	24.00
Total	4,647,895			$5,917,422.41
	1943-1944 Season			
Muskrat	4,743,790	@	$1.44¾	$6,866,636.03
Nutria	436	@	.50	218.00
Mink	144,582	@	4.05	585,557.00
Raccoon	208,010	@	1.15	239,211.50
Opossum	91,033	@	.50	45,516.50
Otter	2,404	@	6.00	14,424.00
Skunk	28,037	@	.50	14,018.50
Fox	8,534	@	.50	4,267.00
Cat	918	@	.50	459.00
Miscellaneous	1,146	@	.50	573.00
Total	5,228,890			$7,770,880.63
	1944-1945 Season			
Muskrat	5,963,156	@	1.23	$7,334,681.88
Nutria	902	@	.50	451.00
Mink	132,821	@	4.05	537,925.05
Raccoon	176,911	@	1.15	203,447.65
Opossum	66,000	@	.50	33,000.00
Otter	1,912	@	6.00	11,472.00
Skunk	11,155	@	.50	5,577.50
Fox	5,124	@	.50	2,562.00
Cat	628	@	.50	314.00
Miscellaneous	86	@	.50	43.00
Total	6,358,695			$8,129,474.08
	1945-1946 Season			
Muskrat	8,337,411	@	1.50	$12,506,116.50
Nutria	8,784	@	5.00	43,920.00
Mink	168,598	@	15.00	2,528,970.00
Raccoon	244,502	@	1.50	366,753.00
Opossum	90,433	@	.50	45,216.50
Otter	2,367	@	20.00	47,340.00
Skunk	12,224	@	1.00	12,224.00
Fox	3,823	@	.50	1,911.50
Cat	1,430	@	.50	715.00
Miscellaneous	37	@	.50	18.50
Total	8,869,609			$15,553,185.00
	1946-1947 Season			
Muskrat	8,029,764	@	$1.00	$8,029,764.00
Nutria	18,015	@	3.00	54,045.00
Mink	153,027	@	5.00	765,135.00
Raccoon	186,750	@	1.50	280,125.00
Opossum	77,264	@	.60	46,358.40
Otter	2,832	@	12.50	35,400.00
Skunk	4,830	@	.50	2,415.00
Fox	2,645	@	.50	1,322.50
Cat	383	@	.50	191.50
Miscellaneous	53	@	.50	26.50
Total	8,475,563			$9,214,782.90
	1947-1948 Season			
Muskrat	5,794,317	@	1.50	$8,691.475.50
Nutria	28,176	@	3.00	84,528.00
Mink	153,120	@	15.00	2,296,800.00
Raccoon	126,933	@	1.00	126,933.00
Opossum	31,744	@	.70	22,220.80
Skunk	1,415	@	.70	990.50
Otter	5,078	@	18.00	91,404.00
Fox	2,528	@	.50	1,264.00
Cat	70	@	.50	35.00
Miscellaneous	679	@	.50	339.50
Total	6,144,060			$11,315,990.30
	1948-1949 Season			
Muskrat	2,948,281	@	1.10	$3,243,109.10
Nutria	26,738	@	3.50	93,583.00
Mink	91,541	@	8.00	732,328.00
Raccoon	104,034	@	.70	72,823.80
Otter	2,222	@	12.00	26,664.00
Opossum	23,713	@	.50	11,856.50
Skunk	1,144	@	.50	572.00
Fox	1,727	@	.50	863.50
Cat	222	@	.50	111.00
Wolf	6	@	.50	3.00
Miscellaneous	759	@	.50	379.50
Total	3,200,387			$4,182,293.40
	1949-1950 Season			
Muskrat	2,195,324	@	.77	$1,690,399.48
Nutria	38,988	@	3.00	116,964.00
Mink	123,850	@	8.90	1,102,265.00
Raccoon	73,035	@	.27	19,719.45
Opossum	16,361	@	.20	3,272.20
Otter	2,968	@	8.00	23,744.00
Skunk	302	@	.15	45.30
Fox	226	@	.15	33.90
Cat	87	@	.15	13.05
Miscellaneous	142	@	.15	21.30
Total	2,451,283			$2,956,477.68
	1950-1951 Season			
Muskrat	2,477,464	@	1.25	$3,096,830.00
Nutria	78,422	@	4.65	364,662.30
Mink	184,552	@	12.93	2,386,257.36
Raccoon	104,420	@	.43	44,900.60
Opossum	27,308	@	.21	5,734.68
Otter	4,801	@	12.15	58,332.15
Skunk	1,006	@	.15	150.90
Fox	1,250	@	.25	312.50
Cat	58	@	1.05	60.90
Miscellaneous	41	@	.15	6.15
Total	2,879,322			$5,957,249.54
	1951-1952 Season			
Muskrat	1,011,202	@	1.09	1,102,210.18
Nutria	77,966	@	2.00	155,932.00
Mink	95,784	@	9.39	899,411.76
Raccoon	89,353	@	.55	49,144.15
Opossum	18,017	@	.24	4,324.08
Otter	4,849	@	11.05	53,581.45
Skunk	1,062	@	.34	361.08
Fox	1,181	@	.45	531.45
Cat	35	@	.25	8.75
Miscellaneous	33	@	.28	9.24
Total	1,299,482			$2,265,514.14
	1952-1953 Season			
Muskrat	1,247,705	@	$1.15	$1,434,860.75
Nutria	89,526	@	2.00	179,052.00
Mink	113,073	@	10.00	1,130,730.00
Raccoon	63,429	@	.50	31,714.50
Opossum	12,114	@	.20	2,422.80
Otter	4,198	@	11.00	46,178.00
Skunk	982	@	.50	491.00
Fox	377	@	.25	94.25
Cat	21	@	.50	10.50
Miscellaneous	2	@	.15	.30
Total	1,531,427			$2,825,554.10

1953-1954 Season

Muskrat	1,173,209	@	.80	$ 938,567.20
Nutria	160,654	@	2.00	321,308.00
Mink	58,706	@	8.50	499,001.00
Raccoon	49,857	@	.50	24,928.50
Opossum	6,344	@	.25	1,586.00
Otter	3,884	@	13.00	50,492.00
Skunk	311	@	.25	77.75
Fox	86	@	.25	21.50
Cat	5	@	.25	1.25
Total	1,453,056			1,835,983.20

1954-1955 Season

Muskrat	1,383,114	@	1.10	1,521,425.40
Nutria	374,199	@	2.05	767,107.95
Mink	65,170	@	15.00	977,550.00
Raccoon	84,223	@	.75	63,167.25
Opossum	7,497	@	.35	2,623.95
Otter	5,407	@	16.00	86,512.00
Skunk	120	@	.50	60.00
Fox	31	@	.50	15.50
Cat	542	@	.40	216.80
Total	1,920,303			$3,418,678.85

1955-1956 Season

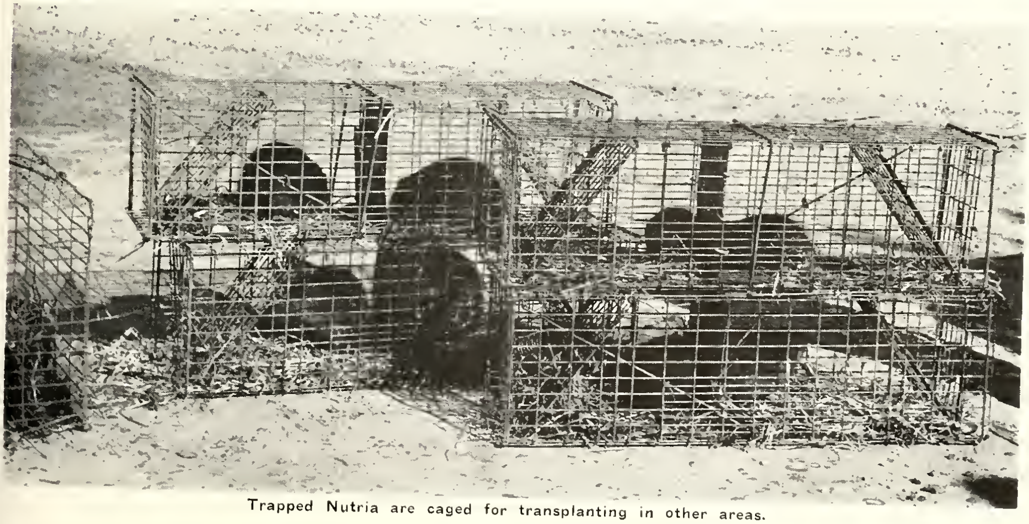
Muskrat	1,821,840	@	.80	$1,457,472.00
Mink	57,142	@	11.00	628,562.00
Raccoon	61,520	@	.90	55,368.00
Otter	4,653	@	18.00	83,754.00
Nutria	418,772	@	1.00	418,772.00
Opossum	6,6,211	@	.15	931.65
Fox	185	@	.25	46.25
Skunk	273	@	.20	54.60
Cat	102	@	.25	25.50
Total	2,370,698			$2,644,986.00

1956-1957 Season

Muskrat	1,589,433	@	.80	$1,271,546.40
Mink	62,872	@	1.00	440,104.00
Raccoon	72,522	@	1.00	72,522.00
Otter	5,261	@	16.00	84,176.00
Nutria	543,160	@	1.50	814,740.00
Opossum	5,056	@	.15	758.40
Fox	76	@	.25	19.00
Skunk	526	@	.20	105.20
Cat	31	@	.25	7.75
Miscellaneous	2	@	.25	7.75
Total	2,278,939			$2,683,979.25

Woman and children too all pitch in to help during the trapping season in the Louisiana marshland.

Here a young trapper wrings out his pelts at one of the State Wildlife refuges.



Trapped Nutria are caged for transplanting in other areas.

A LOOK AT THE FUR INDUSTRY

Once a fifteen to twenty million dollar annual economy in Louisiana—now a three to four million! What has happened? What were the cases and the effects, and could anything have been done about it?

Fur is supposed to be one of the most basic commodities, dating back to the cave-man days and was surely one of the first great industries to be established on the North American Continent. Even now certain large fur firms, to some degree, use furs as a medium of exchange and their worth is gauged in so many hundreds of thousands of mink, persian lamb, squirrels, etc. Furs are kept in storage for many years and certain items converted into cash and in turn the cash converted back into other furs when the market is favorable. But what we are interested in is the present condition of the fur industry in the State of Louisiana.

It is always difficult to write about a trade where your friends have their fortunes, hopes and years of work invested. Today, more than ever before, the furs that are produced have no intrinsic value. It is doubtful that any woman who purchases a fur garment, be it mink, persian lamb, Alaskan seal, muskrat, or nutria places any importance on warmth. Therefore the potential value of our furs is governed mainly by the skill of the manufacturer, dresser and dyer. Unfortunately this phase of the industry has never been participated in in the State of Louisiana.

The physiognomy and ecology of our State has so endowed us that the coastal marshes and swamps produce more than half the number of wild pelts in the United States with Canada included in some years. This has made the fur industry in Louisiana one that has been participated in by 20,000 expert trappers with techniques handed down from one generation to the next rather than a "farm boy hobby" as is practiced in most other states. Because of the efforts exercised by fashion designers, merchants and advertising media that have spear-headed the fight to keep furs desirable, the great production in the State of Louisiana was kept constant. However, all through the years certain of our larger dealers with their intricate knowledge and participation in our "set-up" have acted as a stablizing factor in preventing some deep "troughs" and by the same token leveled a few of the "peaks."

In the early 1920's when the populations of muskrats in the Louisiana marshes had reached such a peak that "eat-outs" were occurring in large areas, trappers began setting their traps at random over these vast marshes with little or no regard for property rights or ownership. Most of the owners of these tracts of land were out-of-state investors who had never given a thought to the value of the furbearers. This was chaos.

Through the keen foresight of several New Orleans fur dealers a method was proposed to the landowners whereby their lands could be posted and poaching eliminated and an orderly organization formed for the sole purpose of establishing a sound industry in the State of Louisiana. This finally resulted in New Orleans becoming the second largest fur center in the United States and establishing the land lease control system. Under this system the trapper did well. It was not unusual for a trapper to clear three to five thousand dollars in a three month's season. This, of course, was not wholly due to this system or method of operation but was due to many circumstances, some man-made and some natural

Furniture, food, pelts and other camping equipment secure on the boat "Houma", these trappers head back for the mainland to begin tilling the soil following a season of trapping on Marsh Island.

that occured at the right time during this peak production and peak prices.

Some very substantial sums of money were accumulated and thousands of trappers and operators were able to invest in ventures other than the fur business. In fact things were going so well for those who were "IN" that all the "OUTS" that wanted "IN" set up a great wave of protest that finally developed into a weak trappers union that proposed to handle the fur industry. This move was soon subdued in the United States Supreme Court. However, this wave of only partially founded protests planted seeds in the minds of the officials and owners of the large tracts of marsh land which finally resulted in their taking over the trapping operations on their own land.

Back in 1944, at the height of our business, both price-wise and production-wise, the author wrote that if the dealers ever lost the ability to produce a large percentage of their furs on their own land leases and were forced to compete on the open market to nurture their business and supply their customers, a complete reorganization may be inevitable. And this has come to pass.

Unfortunately by this time our industry's greatest peak had passed and the miserable creeping fog of decline was settling into every avenue of the industry and it seemed impossible to stem the cancerous situation. The more money and effort expended—the greater the loss. Some dealers that tried to hold their leases and organizations were unable to break even with the greatest effort. Small trapping land operators who trapped themselves, along with their uncles, brothers, children and wives working in the camp, saw their substantial savings dwindle away by doing the same thing that had meant success to them for the past twenty years. During this same period practically all other business in the United States was on the up-grade. The only thing on the up-grade in the fur industry was bankruptcy and suicide.

In restrospect, what was the combination of life-giving circumstances that started the entire fur industry in Louisiana?

Basically we have approximately 4,000,000 acres of coastal marshland and ten to fourteen million acres of swamp and sub-marginal fur producing lands. The coastal marshes and some of the deeper swamps account for 95% of the total fur take. These areas will produce only so much food and cover. The muskrat and nutria eat about one-third of their weight daily. These animals will weigh from two to fifteen pounds respectively which, converted to grass roots and stalks is considerable. Mink consume about one pound of food daily and raccoon are regular gluttons. The average to good fur animal habitats along the coastal marshes have been pretty well tested as far as productivity is concerned. Naturally man's efficiency to manage and collect the fur on specific areas must be considered. The finest muskrat marshes will only sustain five to ten animals per acre for a few seasons, depending upon a number of factors. This compares to one nutria per three acres and a good mink producing marsh, one to fifty acres and the finest deep swamp, one mink to ten acres.

When thinking of the fur industry in Louisiana we usually think only in terms of muskrats and consider the 100,000 mink, the otter, raccoon, etc. as a by-product of the trapping business, except for certain deep swamp areas where mink are of primary importance locally. The exotic and controversial nutria which was introduced into Louisiana in 1937, made itself felt commencing in 1953-54 by compensating for the deep "trough" that was prevalent in the muskrat catch. In 1953-54 the net income to trappers for the entire muskrat catch was $938,567.20 and the income on 160,664 nutrias was $321,308.00.

A Little Charles Camp trapper, with traps strapped over shoulder, views the marsh area for choice spot.

The earliest settlers in Louisiana trapped raccoon, mink and otter but the first official record of the price of muskrats was in 1915, which was 8¢ per pelt. The State's total catch was not recorded until the season of 1924-25, which listed 6,236,165 muskrats. There were a number of years from 1930 to 1937 when the reported catch of muskrats remained just slightly above the two million mark. This of course everyone with the trade knows is not too accurate. The severance tax collection records kept by the Wild Life

The Nutria (Coypu) could well be the answer to the economic problems of the Louisiana trapper, his family and his creditor.

This modern muskrat trapper works his pelt at least three times in order to get a more valuable fur.

and Fisheries Commission from 1939-40 will give a more accurate account of what was happening.

Before 1940 great localized cyclic muskrat populations would occur, eating-out the available food, then slide back to the trough. In seven to twelve years, depending upon a number of conditions such as rainfall, drought, dry marsh burns, storms, etc. the peak would be reached again.

Although storms have an immediate adverse effect, some benefits seem to follow shortly. From examining landowners records taken before 1940 it appeared that it would be a physical impossibility that practically all land would ever produce at the same time. In 1940 a prolonged rainy cycle set in, accompanied by a series of normal tropical hurricanes. The hurricanes seemed to scour and cleanse the marshes leaving new, rich mud deposits which created a nutritious marsh floor resulting in new vegetative growths. The rainy summer retarded the excessive heating that occurs in a dry marsh, which is thought by some biologists to retard summer muskrat populations. Wet cycles maintain a back-log of fresh water, tending to act as a buffer against salt water intrusion. Abrupt tides and salinity fluctuations are both known to adversely effect the finer muskrat food plants.

A vegetative type map of the coastal marsh completed during early 1940 indicated maximum marsh conditions inhabited by an unusually even spread of muskrat populations. There were certain over-populated spots but there was plenty of good surrounding habitat to absorb the colonies' spring dispersals. By this time experience in eat-outs or over-population had taught the trappers that quick draining of the eat-out spots often resulted in immediate return to good feed conditions. Temporary draining prevented the rotting of still viable root systems and allowed the germination of seeds that covered the surface of the marsh muck.

The fur prices were good and the trappers and operators were enthusiastic, in fact, the entire industry was at a peak. The per capita income was on the increase and almost every woman who had always wanted a fur coat was now able to afford one. The entire coat trade for southern muskrats and mink was centered in New York City. Just how many muskrat coats and mink scarves were sold is not known, but they ran into the millions, and the designers were not skimping on the amount of fur used. The coats were serviceable and also glamorous. The fur dyers were able to take the versatile muskrat and almost simulate any color-phase wanted. Because of the suppleness of the muskrat skin the designers were able to create high style garments that were comparable to the more expensive furs

When the designers finally hit upon the full length mink-dyed muskrat coat, it appeared that they thought they had reached the millennium and just walked off to conquer new fields. Mink-dyed muskrat coats became so popular and so plentiful that the regimented look became embarrassing. In fact two coats were accidentally switched in a check room in a night club in Baton Rouge and it was two weeks before either lady realized they had the wrong coat. This was discovered only by the fact that one of the ladies found a different brand of cigarettes in her pocket. Of course there were other factors that crept into the industry sapping its very life such as high labor costs and 20% luxury tax. Women refused to pay $500.00 for a garment with an extra $100.00 tax—perhaps if the tax could have been absorbed in the cost of the coat the effect would not have been as objectionable. At the same time the blue-jean, casual suburban trend began taking hold.

Toward the end of 1947 everything seemed to be sliding at the same time. The marsh could no longer support the terrific beating that it was taking from the 8 to 10 million trappable 'rats—the rainy cycle was over and a prolonged five year drought set-in; industrial activities in the marshes were increasing beyond anything that had ever been dreamed of. Transportation, oil-exploration and exploitation, refineries and chemical plants were moving in to take advantage of the State's fresh water system, fuel and shipping facilities. The past wet cycle had been a boon to the drainage and reclamation enthusiasts as they had money and equipment to get the job done. The back-log of fresh water was evaporating and draining off into the Gulf of Mexico.

Most of our marshes exist at a level of 8 to 12 inches above sea-level and their vegetative growths that are conducive to furbearers are dependent upon the back log of fresh water held along the swamps and agricultural lands. Meandering and winding bayous with natural levees, cheniers, and dense stands of vegetation create lags in run-off's which stablize edaphic conditions of millions of acres of marshland.

But now everything added up against the fur industry. The trapper had already lost the fight against the muskrat; the very cream of the muskrat habitat had been churned into a flat expanse, denuded of solid stands of vegetation, the ditches and water-control structures and had been created by the trappers for travel and management purposes had been abandoned, creating the reverse effect, allowing water and salinity fluctuations. Trappers were forced to seek other means of livelihood.

The entire fur industry at the present time has evolved into one item—"MINK". Whatever quantities of muskrat or wild furs that are produced throughout the United States are mainly consumed by the European market. Perhaps a well rounded campaign hitting every facet, the merchant, the manufacturer, the retailer and of course the consumer, might revive the interest in American wild furs through better fashion, better dying and dressing and construction. A sound promotion and publicity program might create a consumer acceptance of all the wild furs produced in the State of Louisiana.

THE NUTRIA IN LOUISIANA

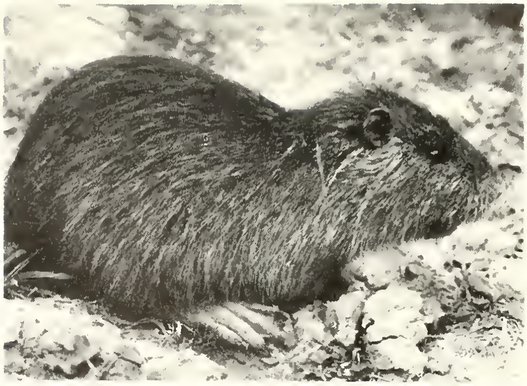
By Ednard Waldo

THE nutria, erstwhile bete noir of Louisiana's marsh and farmlands, will neither destroy our muskrats nor eat the state's agriculture out of house and home, but will remain as a stable $1,000,000 adjunct to our fur industry, scientists say after two decades of studying the animal. The reason being: Nutria habitats are reaching their carrying capacity and the fur bearing animal has reached its production peak and is settling back to normal.

Brought to Louisiana in the early 1930's by the late E. A. McIlhenny, of Avery Island, from South America as an experiment, a score of the animals dug their way out of an "escape proof" pen during a hurricane and made their way to the marshlands and from then on the prolific fur bearers began to multiply with the rapidity of the rodents in the late Ellis Parker Butler's "Pigs is Pigs."

Within a matter of several years, after their number had been augmented by some more importations, the nutria began to appear practically everywhere on the Louisiana marshlands in unheard of numbers. The nutria fur take, in the 1943-44 season, was 436 pelts; by the 1950-51 season it had jumped to 78,422 pelts; last year the take was more than a half million pelts and farmers began to complain about incursions of the nutria into their rice and cane fields. It looked for a while like the voracious and prolific vegetarian was going to literally eat the state out of house-and-home. What made things worse, trappers complained, was that nutria pelts, which once had sold for as high as five dollars had dropped to one dollar per pelt and in some cases were being bought in the marshes for as low as twenty-five cents each.

One of the reasons for the drop was the poor and unwise handling of the nutria by our American merchants. As prices went down trappers found that a man could carry 20 muskrats out of the marsh in place of three or four nutria weighing as much as 15 to 20 pounds each, so the taking of the low-priced nutria became a liability. Moreover the worthless young nutria which follow the muskrat runs were getting caught in the muskrat traps, and the grown nutria were snapping the muskrat sets (traps) with their long, webbed hind feet and long tails. So the all-around fur take fell off and so did the number of trappers who abandoned their lifelong avocations for the steady payrolls of the oil and kindred industries.



This picture shows a good view of the nutria's webbed hind foot. Forepaws are like that of a raccoon.

In the 1955-56 season only 4000 trapping licenses were purchased from the Wild Life and Fisheries commission in comparison with the 20,000 taken out a decade ago. At an average of two trappers to the licensed camp this meant only 8000 trappers in the marshes. This was a sad outlook, indeed, for the Louisiana fur industry which had once produced more pelts than the rest of the United States, Alaska and Canada put together. However, according to Ted O'Neil, Chief of the Fur Division of the Wild Life and Fisheries commission, the picture has changed and the nutria, while it will not produce the predicted $12,000,000 fur crop, will remain a valuable addition in the Louisiana fur picture.

In making his prognostications O'Neil cited the lands of the Louisiana Fur Corporation in Vermilion parish as a good

Light patches in the foreground are nutria nests, in background is rice field.

example of the carrying capacity of some of the finest nutria lands in the state.

"This property consists of about 154,000 acres of the best nutria habitat in Louisiana. At its peak it produced around 68,000 pelts and when this peak was reached there was a noticeable decline in population of pelts taken indicating that the marsh had passed its carrying capacity, as for an instance, the take dropped to 49,428 in the winter season of 1953-54; in the season of 1954-55 it went up to 62,807; in 1955-56 it dropped to 52,096 pelts and the 1956-57 season produced 45,014 pelts. This season 1957-58 is, of course, down to 15,000 due to the death toll caused by Hurricane Audrey."

O'Neil states that there has been considerable damage to crops in the fields on the edges of the marshes and to fields bordering on steams leading to nutria inhabitated areas, however, the U. S. Fish and Wildlife Service and the biologists of the Wild Life and Fisheries commission are at present working out methods to produce specific toxins that will prevent further crop damage.

"From the standpoint of fur production the fur trade is not particularly interested in those nutria produced out of the normal habitat of the marshes because the fur quality is not generally good," O'Neil says. "Dry habitat causes wear outs in the underside of the pelts along the bellies and legs. Cockle burrs, brambles and other undergrowth cause streaks on the legs and belly fur, thus making the pelts undesirable."

Dogs are no match for the Nutria's powerful teeth. This hound was saved from sure death by the quick first aid of its master.

At present the trapper gets a base price of $1.75 to two dollars for pelts 26 inches or more; these are No. 1 pelts and by the time the catch is graded down the pelts will average about eighty cents to one dollar each. In some cases buyers have gone down into the marshes and taken advantage of the trapper's ignorance of prevailing market prices and obtained pelts for as low as twenty-five cents.

The problem now is to get the trapper's price up to an $1.50 average base price per pelt. Lack of competition in the market has caused this low price. Buyers have gone back to the muskrat market, as for an instance 1,000,000 muskrat pelts were purchased during the 1957-58 trapping season in St. Bernard parish alone. New retail buyer demand must be created for the ntria among the furwearing public.

"With the proper advertising, an informed public will immediately take to this truly remarkable fur which is almost second to none in elegance and durability. We see no reason why, with this impetus, the trapper may not obtain at least $1.50 per pelt. This would mean that with this added incentive to trapping the nutria, the take could be upped to three quarters of a million pelts resulting in an annual fur income of over a million dollars," O'Neil says.

Harvesting of the nutria meat for the market would additonally net the trapper twenty-five cents per carcass and it is estimated that if this is done it will be possible to bring at least 300,000 carcasses to the market. At present the Wild Life and Fisheries commission is working with several packing concerns toward this end. The meat of the nutria is not only delectable for human consumption, but is in great demand for dog and mink foods and methods are being evolved for getting the meat to concentration points in good condition. It also has been reported that orders have already been placed for tons of frozen nutria for shipment to mink ranches in the West.

About 20% of our nutria fur is used for outside coat material and the rest is in constant demand for linings known as "plates" in the industry. Nutria fur make the best and richest coat linings.

Actual prime production habitat for the nutria consists of about four million acres of marshlands which have a producing capacity of one pelt to three acres. The rest of the lands now being partly occupied by the nutria are the alluvial lands of the state and the rice and sugar belts and lakes and river bottoms throughout the southern and central parts of the state, however, the nutria fur producing habitat are the marshes. North Louisiana has never produced anything in the way of nutria pelts. The nutria eventually will relegate the major part of its populations to its natural habitat in the deep cattail and sawgrass marshes; nutria will usually seek this type of habitat which has never been top muskrat territory.

In the case of the nutria versus the muskrat, nutria will disturb the muskrat nests and small nutria will get into the trappers' muskrat traps. However, nutria and muskrat will not engage in combat and have been raised together in the same cages. As concerns its reputation for viciousness the nutria is more than a match for the best dog, however, it will not attack unless it is attacked first. Nutria make good pets, however, they are temperamental animals. In a litter some will be found that are naturally tame and others that are utterly intractable.

Whereas Louisiana has lost, we hope temporarily, its place as top producer over Alaska, Canada and the rest of the United States combined, the state is not alone in its decline of fur production for many other sections have suffered proportionately. Yet in spite of this the state led the nation in the production of the most important furs; for the 1955-56 season: Mink, 57,142 pelts; Muskrat, 1,821,840 pelts; and, nutria, 418,722 pelts.

In a total take of all pelts of 8,153,943 for all of the United States and Alaska, Louisiana still led all sections individually with a take of 2,270,698 pelts, or more than one-fourth of all pelts taken, according to the report on the fur catch for the 1955-56 season compiled by the U. S. Fish and Wildlife Service of the Department of the Interior.

In summing up the raw fur situation in the United States, the U. S. Fish and Wildlife Service reiterated the opinion of O'Neil when it stated in its report of June 1957, "The raw fur situation continues to be uncertain. It has been quite evident during the past few years that general improvement in the fur industry is practically impossible unless there is a greater diversification of furs used in good quantities in the manufacture of garments. Mink has been the fur in greatest demand but the fur trade must be more than a one-fur industry if it is to be economically healthful. This situation is causing a continued decline in trapping operations because trappers can make little profit from their traplines. Meanwhile the fur trade continues in its efforts to revive the demand for the neglected furs."

Along the streams in the torrid zones of Argentina, Brazil and Chile, its native habitat, the coypu nutria is regarded as the South American Beaver or Beaver Rat. In those countries it is known solely by name as the *coypu* and its fur or pelt is called *nutria*. However, the latter word being more convenient to our American tongue, this strange rodent has become known almost throughout the United States as the *nutria*.

For scientific purposes the animal is called *Myocastor coypus* (Molina); Phylum, Chordata; Subphylum, Vertebrata; Class, Mammalia; Order, Rodentia; Family, Capromyidae.

You don't have to look for the nutria, there'll be tracks aplenty if they are around.

The nutria is of such a specific type that it is difficult to make comparisons with rodents of its order. Unlike the beaver it has a round, long, scaly and somewhat thin tail which looks like that of a rat.

As for other physical characteristics, the nutria looks somewhat like an overgrown guinea pig, with a rat's tail, of course. Its body is solid and heavy and its belly barely skims level ground when it is walking on all four legs.

For further details we quote Dr. L. J. Billelo, biologist of Houma, La., who aptly describes the nutria's external features with the eyes of a scientist.

"Its short neck and solid wide head narrows towards the eyes and the mouth. The eyes are small. The iris of the eyes are dark brown and the pupil is slightly rounded. The light of the sun contracts the pupil to form a vertical line. The ears are small with slightly rounded lobes; they can close over when the animal is under water. The nutria can stay under water for seven minutes. The total configuration of the male is wider and stronger than the female. The female has a slightly longer snout than the male. The front and hind legs differ somewhat in that the front legs do not support much weight and therefore are shorter and smaller. The front feet have four digits each. They use their front appendages to hold food that they eat and take it to their mouths. The hind legs are very stout, larger and stronger than the front legs. There are five digits on each hind foot held together by the tough membrane or web so necessary in swimming. When in the water, the nutria uses only the hind legs for swimming. The tail is about two-thirds the length of a nutria with a thick prominal part having an abundance of hair and no hair to be seen on the distal one-third of the tail.

Besides resembling a king-sized guinea pig the nutria also has a large rat-like tail and powerful teeth.

"The naked, round tail readily distinguishes the nutria from other North American semi-aquatic fur bearers. The hind feet are webbed and the ears are small and lie close to the skull. These are, no doubt, specializations for aquatic life.

"A full grown nutria will have a length of about twenty-five inches and a tail of sixteen inches. It is said that some nutria weigh as much as fifty pounds, but they generally range in weight from nine to eighteen pounds, depending of course, on the age and sex of the animal. Large orange colored incisor teeth are set deep in the mandible of the lower jaw and maxilla of the upper jaw. They range from one to two inches above the ginjiva in length and fit with the upper incisors overlapping the lowers with the curvature of a semi-circle. The dental formula of the nutria is: i 2/2, c 0/0, p 0/0, m 4/4.

"The color of the nutria is sort of red-brown along the dorsal and dorso-lateral area and black-brown on the ventral side. The fur of the animal is sometimes used in a plucked condition. The undercoat of fine soft hair grows to a thick bluish-gray color.

The female nutria has four or five teats on a side. Teats are in a dorso-lateral position (on its back instead of its belly) which is unusual in the rodents and is no doubt an added specialization. The young can be suckled while the mother is swimming."

According to biologists Cargera and Yepes, who made a study of the nutria two decades ago, the male nutria matures sexually at eight months and the females average from six to seven months. The gestation period lasts from 127 to 132 days with two litters a year being produced and sometimes five in two years.

From two to nine young are born and up to 13 has been recorded, but this is exceptional. The females, giving birth

These trappers not only realize profit from nutria pelts but also from sale of the delectable nutria meat.

for the first time, have from two to five with an average of four.

The young nutria are born with their eyes open and fully covered with a baby fur coat and tiny webbed feet and take to water when only 24 hours old. The nutria engages in polygamy by living with two or three females and the average age of the nutria is four years. Some live as long as seven, however, this is unusual.

The nutria is a twilight type of animal. That is to say, it goes to the banks of water for food in the late afternoon or early evening. A nutria will usually use the same trial in going to and from food. It is seldom that the animal stays away from its nesting place overnight but when it does stay away, it always comes back in the early morning before the sun comes out.

The sight of the nutria is believed to be used to see movement rather than the detail of the area. Hearing seems to play a greater role in living than does sight. Objects pawed by the nutria are studied by touch more than by smell. Tactile corpuscles located in the paws or feet are very sensitive to touch.

Myocastor is a semi-aquatic rodent which makes its hideouts artificially above water or in caves, along banks of rivers, and always near roots or readily available vegetation which it uses for food. Water is said to be indispensable for its life and is very necessary for prime fur. Tunnels are usually about four and a half feet in length and about ten inches in diameter. Nests are often seen on floating islands of very thick vegetation. Reeds are bent and interlaced above the water's edge by the clever weaver. The female nutria always cleans, rests and dries herself before going back on her nest. Therefore, her nest is always kept dry.

As all forms of animal life may become sick from overeating or lack of food, so will the nutria. And according to biologists, too much food in the diet will cause a fat nutria to become prone to disease and indifferent towards reproduction. Perhaps this may be the key to nature's way of stabilizing populations. Females become sterile by hypertrophy of the ovaries. An animal that is very fat will produce a pelt that is greasy, hard to dry and more prone to infection.

Where nutria are plentiful, excretia may be in abundance and parathypiod with parasitic infections may become prevalent, Billelo has noted. Tuberculosis, false tuberculosis and septicemia are diseases which have been found to infect the nutria in some geographic areas.

External parasites such as protozoans, lice and worms may cause the fur of the animal to become worthless. Generally an insecticide will destroy the pests in a matter of days.

An internal parasite has been noted to cause coccidiosis; a form of blood shedding due to a protoaoan. Three groups of intestinal parasites are known to be destructive in some South American areas. The parasites fall in the groups or classes of nematodes, cestodes and tremetodes.

Whereas nutria are comparatively new on this continent, the "Ragondin" as it is called in France has been raised in captivity since it was introduced there in 1882 and its fur is familiar to the French people.

"Although at the present time there are very few nutria coats of any kind in existence, this rarity, it is believed, is due solely to the fact that women the world over have not learned of the beauty, luxury, comfort and serviceability of this unusual fur now in abundance in Louisiana", O'Neil says. "The nutria is a member of the beaver family and its fur is even more serviceable than the beaver or its little brother the muskrat.

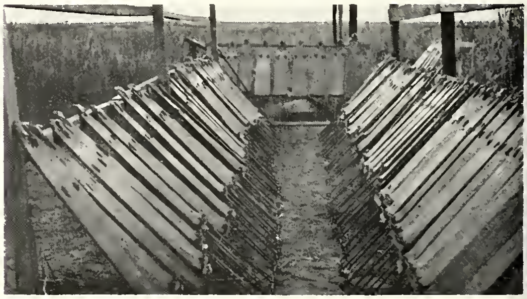
"When the nutria pelt is properly taken and processed, it provides a fur as soft as mole skin, extremely light in weight and equally extremely durable. In addition, when properly processed, it lends itself to dye better than any other fur making it possible to produce fur garments of even, beautiful and lustrous pastel shades."

"More Louisiana women and girls are having nutria jackets and coats made from skins obtained locally and in every instance milady is extravagant in her praise of a garment manufactured of this fur."

Another allied industry that might add a million or more dollars to the fur industry would be the development of the processing end of the fur trade. Skins of all kinds, not only the nutria, could just as well be processed here if enterprising raw fur dealers would take the bit in their mouth and import and develop artisans in this trade instead of shipping our furs away to be processed, O'Neil says.

The most successful fur-farmers of nutria were the Germans. There it was found that one man could easily manage a large nutria farm because concrete pools and numerous labor-saving devices were installed to better the living conditions of the animals. Russia, Denmark and Great Britain have found some success in fur-farming with the nutria. In the United States various nutria "farms" have mushroomed. Most of them advertising "do-it-yourself" methods for purchasing pairs of nutria and becoming rich overnight. One "fur farm" is said to have advertised the animals for as high as $1,000 per pair promising almost immediate returns of $30 per pelt for the nutria. So far as it is known no nutria pelt has been sold for more than $9.00 on the fur market.

As regards agricultural damage by nutria, biologist Allan B. Ensminger of the Louisiana Wild Life and Fisheries Commission says in his report entitled "The Economic Status of Nutria in Louisiana": "It is easy to understand why rice is the most drastically effected of the agricultural crops utilized by nutria as food. The nutria being a semi-aquatic



Trappers set out nutria pelts to dry on racks such as these.

animal spends much of its life in or near water. Fields of rice flooded with water will naturally attract nutria as they furnish a ready food supply and plenty of water in which to swim. The most pronounced damage to rice production is the burrowing into and cutting of large irrigation canal levees. In most cases, the nutria that burrow into a levee are following and enlarging a burrow made by muskrats which are common in all of the canal systems in south Louisiana. Since the nutria is several times the size of a muskrat they naturally require a much larger tunnel to rest in. As the burrow is enlarged the chances of it becoming a break in the levee is much greater. Running water seems to attract nutria and quite a lot of digging activity is found about the pumping installations in rice fields. Constant vigilance is required of the farmer to detect burrows, dig them out and repair them.

The small water control levees throughout the rice fields which provide excellent resting sites for the nutria are often cut by the animals during the night allowing an entire rice field to wash out. When machines are used to repair levees quite a lot of rice is mashed down and lost; however, most of this type of damage can be averted by having a laborer check all of the small levees and repairing them manually each morning.

Young rice does not provide sufficient cover for daytime, or for the rodent's customary twilight feeding, therefore, most nutria activity is at night and concentrated along the large irrigation canals. As the rice crop develops, the nutria move out into the fields and remain there until the rice is harvested. Often several nutria are killed by the harvest crew as a field is being cut. Nutria utilize the stems of rice for about five (5) inches above the ground. It appears that an animal will cut in one place until a small opening of 10-15 feet is made. Any rice stems that are cut off below the water level usually die, while those cut off above the water will stool out and produce another top, however, this growth will not mature a seed head in time to be harvested when the field is cut.

The greatest damage to sugar cane occurs on the few cane plantations located along the northern rim of the marsh. Some of these fields have protection levees around them to keep high water in the marsh from flooding the sugar cane. Nutria have burrowed into and cut several of these levees allowing large fields to be flooded for a few days. This flooding causes a reduction in the cane yield.

Nutria will feed on the stalks of sugar cane and in some cases have cut the cane along the outer edge of a field in large enough spots to reduce the field's production for the season.

The Marshes of southwest Louisiana are broken by shell ridges that were once the beach of the Gulf. Corn is the principal crop on some of these inhabited ridges.

Nutria move out of the surrounding marsh at night and feed on the corn crop. Some damage has been caused to corn in areas outside of the marsh where nutria have moved inland along the larger streams of the state.

A few garden plants such as cabbage, lettuce, and peas are cut by nutria.

In a few cases nutria have burrowed and dug around highway bridges and culverts causing damage to the structures.

Another activity of the nutria which may become an important factor in Louisiana is the cutting of small hardwood trees. This condition is especially important where trees are planted around a camp site in the marsh.

Much of the criticism of nutria in marshes where muskrats were being produced may not be justified. No doubt nutria and muskrat do compete for some food plants but the muskrat is more of an underground feeder, rarely feeding on vegetation above the ground surface. whereas nutria feed mainly on the stems of vegetation above the ground surface. As the vegetation grows, only the basal part of the plant is used. Eat-outs, a condition quite common in our marshes, caused by nutria are unlike those of muskrat, where the root stock is completely destroyed. An eat-out caused by nutria may be revegetated in one season whereas a muskrat eat-out may take 8-10 years, therefore, it is easily seen that a nutria eat-out is only a temporary opening up of the marsh vegetation.

This curious nutria baby came out to have a look at the camerman.

At first it was believed that nutria would fight with muskrats but this appears to be untrue, as abundant nutria and muskrat sign can be found in areas where the two animals are found together. It seems to be unlikely that there is any social conflict between nutria and muskrat. Possibly the greatest damage caused in muskrat marshes by nutria is the hastening of eat-outs and the increased trouble during the trapping season. Many small nutria are taken by the trapper which would make undersized pelts and are subsequently discarded. A number 2 trap is needed to satisfactorily trap nutria, whereas a number 1 is used for muskrat. Nutria pelts require several times as much care and attention as muskrat. After the animal is skinned the pelt then has to be fleshed or scraped. This process required about 5-10 minutes depending on the trappers' ability. Nutria pelts are stretched on a metal mold to dry. Two days are required to properly dry the pelts. It is probable that most of the criticism of nutria was due to increased labor in trapping. With new methods for fleshing and drying, most trappers became satisfied with trapping nutria.

In several marshes being managed for waterfowl production, nutria have been found to be of value in opening up stands of dense vegetation, thus making natural ponds throughout the marsh, and permitting duck food plants to become established. Millet is one of our best duck foods which will invade a marsh opened up by nutria.

The grazing of cattle in the marsh has become increasingly important in the last few years. There is some direct competition for food between cattle and nutria but the main damage caused by nutria to cattle marshes is the opening up of the marsh and making it difficult and in some cases impossible to burn off the old dead vegetation. As fire is the principle management tool in marsh management, this condition can be very bad for the proper management of a marsh regardless of the manager's aim.

Since the introduction of nutria into Louisiana there has been a lot of stocking of nutria into farm ponds and lakes over the state and into east Texas for the purpose of removing undesirable aquatic vegetation and weeds. Improper construction with shallow water areas is usually responsible for the presence of weeds, therefore, nutria at best are only a temporary respite from the trouble. Very little has been

Nutria fur is the equal of that of its cousin the beaver in beauty and durability.

gained from stocking nutria in ponds and lakes other than the satisfaction of seeing a few cattail and cut grass clumps removed from the pond margin."

Many people regard the nutria as a predator and demand that it be treated as injurious. Up till now the law has exempted it from this category and in the marsh it is subject to the same regulations applying to other fur bearing animals. It cannot be trapped except during the regular trapping season and may not be taken with a firearm. However, there is one exception to this law which protects all fur-bearing animals in the state. If the nutria are inflicting sufficient damage on a landowner's property he may apply to the Law Enforcement Division of the Louisiana Wild Life and Fisheries commission and a game agent will be sent out to the location to inspect the damage. If the complaint is warranted the landowner will be issued a special permit by the Fish and Game Division and he will be allowed to do away with the intruders by trapping or the use of firearms. However, in no case will he be allowed to eat the flesh of the animals or make any use whatever of the pelt."

So—If you should happen to run across an animal that has teeth like Bugs Bunny and looks like a king sized guinea pig don't be astonished—it's a nutria and you may find him anywhere. Someone even ran across a pair near the Canadian border. Furthermore his front and back feet won't match. Up forward, Mr. Nutria has a pair of paws like a coon and aft, his feet are webbed. He's a vegetarian and eats practically anything in that line . . . and if you should happen to take your eyes off him, that is her, don't do a double take because there'll probably be a half dozen more running around . . . Mrs. Nutria multiplies and compounds semi-annually.

Pelts in bins at warehouse.

Muskrat beds reappear in marsh.

DIVISION OF REFUGES

RICHARD YANCEY

Chief

The Refuge Division is responsible for the improvement, operation and protection of four (4) separate coastal marsh areas totaling 182,400 acres. This includes the 85,000-acre Marsh Island Wildlife Refuge in Iberia Parish, the 83,000-acre Rockefeller Wildlife Refuge in Cameron and Vermilion Parishes, the 13,000-acre State Wildlife Refuge in Vermilion Parish, and the 1,400-acre St. Tammany area bordering Lake Pontchartrain.

During recent years the importance of these wildlife refuges has rapidly increased. In future years the associated values can be expected to greatly magnify as civilization continues to encroach on the few remaining wilderness marshland areas. At this time the coastal marshes of Louisiana are being literally cut to pieces with canals constructed for navigation, drainage, flood control and a multitude of other development purposes. Little or no regard is being provided for wildlife in these construction projects and as a result the quality of Louisiana's coastal marshes, with its associated natural wealth is rapidly dwindling. In the conceivable future the refuge areas may serve as the last favorable habitat to which the many forms of marsh wildlife can retreat.

The program in managing the coastal refuge areas has been divided into four major phases, so designated as administration, maintenance, development and research.

The Refuge Division of the Louisiana Wildlife & Fisheries Commission is charged with the responsibility of administering the refuges on behalf of the State of Louisiana. These areas were originally received under deeds of donation from separate foundations and estates. A number of very specific terms and stipulations were included in each deed and these conditions are being followed very closely in the administration of the refuges.

All new policies pertaining to management of the areas are established by the Louisiana Wildlife & Fisheries Commission during regular monthly meetings and these directives are channeled to the Refuge Division by the Director. Whenever certain assignments involve other departments of the State cooperation is requested from them in order that the job specified may be completed. For individual projects that can be completed with the existing division personnel and equipment all instructions are conveyed to the field from the Refuge Division office in New Orleans. The accomplishments completed during the past two years by the Refuge Division could not have been made possible except for the full and able cooperation of the Louisiana Department of Public Works, the State Mineral Board, and the Division of Administration.

The maintenance phase of the existing program includes all routine work such as patroling the refuges and the upkeep of all existing facilities. This includes water control structures, boats, buildings, draglines, etc.

The development projects include all work on new phases of management. This includes the installation of new water control levees, structures, or other construction work.

RICHARD YANCEY

The research portion of the program includes all investigation, studies or evaluation efforts. This program is being directed towards the development of a sound system of marsh management techniques that is greatly needed at this time. Only through the findings of research can completely sound development projects be placed into effect. Part of the existing personnel in the Refuge Division is trained in the techniques of research since three individuals have M. S. degrees in Wildlife Management from Louisiana State University and one has a B. S. degree in biology.

The details of the work accomplished during the past two years are included in this report and several references are made to future plans. The outstanding event of the past two years occurred on June 27, 1957, with the arrival of hurricane "Audrey". A grim lesson was learned from "Audrey" and it is one that will not soon be forgotten. The results of this catastrophe are outlined as follows:

EFFECTS OF HURRICANE "AUDREY" ON THE COASTAL REFUGES OF SOUTHWEST LOUISIANA

On the morning of June 27, 1957, "Audrey" the first hurricane of the season, struck the southwestern Louisiana coast with a force completely unequalled in the memory of those who lived in the region. The storm resulted in disastrous losses of human life and property in the occupied areas of Cameron, Vermilion and Iberia Parishes and great numbers of mammals, birds and reptiles perished in the marshes. The coastal refuges, located in this region, received tremendous damage to the many fine facilities being used for servicing these areas.

According to gauge readings tides reached 11.3 feet above sea level at the Rockefeller Wildlife Refuge and prevailing winds exceeded 100 miles per hour. Although the State Wildlife and Marsh Island Refuges were over 60 miles east of the hurricane's center, tides increased water levels to 8.3 feet

Sixty-one trapping camps were destroyed by Hurricane "Audrey" on the refuges.

above sea level and winds ranged from 75 to 85 miles per hour. In general the marshes are only 1 ft. above sea level and this resulted in complete inundation by waters from 7.3 ft. to 10.3 ft. in depth. Highest ground on the refuges were stranded beaches, Indian mounds, and levees and all were submerged beneath the racing storm driven tidewaters. A small percentage of the mammal population succeeded in clinging to small drifts and other floating debris until the storm subsided and these were virtually the only survivors. All of the extensive improvements formerly made by the Louisiana Wildlife & Fisheries Commission were severely damaged.

Installations and Equipment Losses.

The installation and equipment losses were extreme because of the very severe forces unleashed by the hurricane. Strong winds, high waters, pounding waves and inundation by salt water were all contributing factors in the destruction of the many fine facilities on the refuges. Totally lost were two dwellings, one general quarters building, two offices, two laboratories, two garage apartments, 61 trapping camps, 4 vehicles, one 38-ft. cabin cruiser, one 20-ft. Chris-Craft, 5 mud boats, 2 marsh buggies, several outboard hulls, several pumping engines, 2 large electric generating plants, one 300-ft. radio tower with radio transmitter and receiver, and numerous small items of equipment. Partially demolished but repairable facilities included; 4 major camps constructed on pilings, one large boathouse and workshop, one 50-ft. diesel boat, 3 draglines, 4 mud boats, two 1000-gal. butane tanks and several engines.

Levee and Beach Damage.

On Rockefeller and the Marsh Island Refuges there are approximately 120 miles of levees originally constructed to form individual impoundments. These levees are very important in restricting salt water intrusion and holding fresh water in the marsh. As the storm tossed waters engulfed the refuges the levees surrounding the impoundments were broken in a number of places and badly eroded for many miles. The breaks greatly enlarged as the water rapidly receded and drained from the level full impoundments. Some side collapse and slumping of the levees from the rapid fall of water was noted, however, wave wash was slight because of the rapid rise in water. Levees running east and west received greater damage than those running north and south, and levees exhibiting good grass coverage suffered little or no damage.

The impoundment water control structures were undamaged, although most of the platforms and walkways leading to the control valves were swept away. Large concrete control structures in strategic waterways, which allowed passage of boat traffic but prevented salt water intrusion, were undamaged. However, each was washed around at the point where concrete wings were covered with earthern material. Each washout was about six feet wide and over 10 ft. deep. The greatest washing occurred as the water rushed back into the Gulf of Mexico.

Measurements after the hurricane revealed drastic changes in beach deposits. It is believed that most of the damage was done in the 24 to 36 hour period prior to the arrival of the hurricane and tidal rise. At Joseph Harbor and Little Constance Bayou on Rockefeller the beach was washed back

One of four headquarters buildings at Rockefeller refuge destroyed by "Audrey".

between 80 and 110 feet. The section of beach around Rollover Bayou had moved little, but cuts or wash-outs 5 to 10 ft. wide occurred at intervals of 30 or 40 ft. along the beach. These cuts were filled in within several weeks by new material washing in by wave action. The total land lost on Rockefeller Refuge during this bried period was approximately 200 acres.

Measurements at Chenier la Croix on Marsh Island showed that the beach was thrown back for a distance of 40 ft. and lowered in elevation from 1.0 to 1.5 feet. Approximately 10 percent of the trees were blown or washed away and the remainder either downed or heavily damaged.

Wildlife Losses.

Wildlife losses appeared staggering when first examined but upon a closer analysis it seems that normal populations of most species should be restored in a few years. Heaviest losses occurred among the smaller and more selective or less adaptable animals, such as nutria, muskrat, raccoon, rabbit and deer. On Rockefeller the loss approached 75 percent and on Marsh Island between 80 and 85 percent. Mink and otter losses were considerably less.

Prior to the storm vast numbers of nutria were found on the refuges, even though the populations had passed a cyclic peak during 1952 and 1953. Following the storm, dead nutria could be found anywhere in the regions north of the refuges. Large numbers could be seen in the drifts along the canal banks and scattered through the marshes. On July 29 it was estimated that on White Lake alone there were 35,000 to 40,000 dead nutria. A similar condition was found on Vermilion Bay and West Cote Blanche Bay.

Prior to "Audrey" the coastal refuges of southwest Louisiana contained only limited muskrat populations, but even these were seriously depleted. Only a few dead muskrat were actually seen, but the fact that only a few muskrat were present afterwards indicates that severe losses did occur.

Deer were abundant on State Wild Life and Marsh Island Refuges before the storm and a few were appearing on Rockefeller Refuge. After the storm only a few remained on any area. The fact that a few deer survived indicates that marsh deer are very hardy animals.

Rabbits were formerly found in extremely large numbers. Following the storm rabbit carcasses were found along a 10-mile Marsh Island levee at about 75-ft. intervals. Very few are to be found on any of the refuges but a rapid comeback can be expected from the survivors.

The greatest damage to birds seemed to be nest destruction. The hurricane struck during the middle of the nesting season and all nests were destroyed. Of the dead birds seen after the storm, 95 percent were rails and gallinules. Many birds renested after the storm.

An odd result of the storm was the fact that large numbers of reptiles also perished. Although alligators are considered the most hardy major animal species in the marshes, they were killed in fairly large numbers. The alligator population received far less losses than did the fur-bearers and a number were seen shortly afterwards on the refuges. The alligator

Commission dragline dredged access channel for SLI Wildlife laboratory on State Wildlife refuge.

This clearly illustrates damage to levees surrounding marshlands improved by Wild Llife Commission for wildlife.

Rockefeller Refuge Camp following hurricane.

Rockefeller Refuge Camp completely restored.

nesting season was well advanced at the time of the hurricane and all nests of these reptiles were destroyed.

Wildlife Habitat Damage.

Large mats of vegetation and plant debris were torn from sections of the marsh. Much of this material was deposited in bayous and lakes. As a result many navigable streams were blocked and the immediate value of many lakes greatly reduced for waterfowl since large amoungs of widgeon grass and other aquatics were swept out of the ponds by currents. This material, however, may tend to check the rapid tidal exchange in certain areas and eventually increase their value. It is possible that much of the sod deposited in shallow lakes will grow and eventually reduce the lake's size. Many of the large vegetative mats were ripped from the unstable banks of other lakes, thereby increasing their size. Many of the mats were removed from old muskrat "eat outs" that had begun the slow process of revegetating.

Before the storm many lakes held dense growths of widgeon grass and other aquatics. However, with the rushing water most of this material was swept from the lakes leaving them almost barren. Nevertheless, much growth was made

More than 155,000, or 40-percent of the world's population of blue geese wintered on the three Commission-managed wildlife refuges in Southwest Louisiana in 1957.

after the storm and by the time of waterfowl arrival the lakes were again partially productive.

Damage from salt water was evident only on the Rockefeller Refuge. Fortunately the water covering Marsh Island and State Wild Life Refuges was practically fresh. Spot checks after the storm by refuge biologists revealed only trace amounts of salt in the water. Fresh water, deposited into the Gulf of Mexico before "Audrey" by the flooded Atchafalaya River, virtually surrounded Marsh Island and State Wildlife. Then with the rapid rise during the storm this water was simply dumped on the refuges. The Atchafalaya water did not reach as far west as Rockefeller, consequently salt water was brought in.

Some of the salt water was trapped in the impoundments for several weeks before it was flushed out by rain water even though all drainage outlets were opended immediately following "Audrey". This condition caused a great decrease in the amount of waterfowl and other game food plants for the 1957 wintering season. Less salt tolerant plants such as bullwhip (*Scirpus californicus*) were damaged and some stands destroyed. Fresh water trapped in an impoundment on Marsh Island for several weeks, before it could escape through broken levees, damaged plant growth because of excessive water depth.

Un-impounded marsh areas on Rockefeller Refuge exhibited very little damage from salt water. This can be explained by the fact that first; excessive rainfall before the hurricane had saturated the marsh with fresh water, second; numerous drains aided in the rapid removal of salt water, third; excessive rainfall after the hurricane helped flush out salt water.

MARSH MANAGEMENT ON THE REFUGES

Before any marsh program can be initiated objectives must be set forth as to the type of results desired. Fortunately the technique used in improving a marsh for one species of marsh wildlife is generally compatible with improvement procedures for other forms.

An excellent combination in coastal marsh management is considered to be the production of three-cornered grass (*Scirpus olneyi and robustus*), spikerushes (*Eleocharis sp.*), wild millet (*Echinochloa walteri*) and other seed producing annuals in the marshes and widgeon grass (*Ruppia maritima*) in the marsh ponds. Three-cornered grass is the most favored food of blue geese and muskrat on the Gulf coast, wild millet and seed producing annuals are choice food plants for puddle ducks such as mallards and pintails, and widgeon grass is a very desirable aquatic food plant for nearly all ducks especially baldpate and gadwalls.

Hurricane damage to Refuge installation.

On the Rockefeller Wildlife Refuge 22% of the total area is leveed in as impoundments and the remaining 78% is virtually uncontrolled. On the Marsh Island Wildlife Refuge 10% of the total area is leveed in as impoundments and the remainder is still in its natural state. It is in these uncontroled areas that future development efforts wll be primarily concentrated. For the most part these undeveloped

Commission employee looks at muskrat beds beginning to reappear on State Wildlife refuge.

areas cannot be impounded because of the unstable quality of material available for construction purposes.

With rapid increases or decreases in tidal exchange and frequent changes in salinity, plant community types also

Water Stabilization.

The above combination of desirable vegetation can best be produced in areas where water levels, salinities, tides and other conditions affecting plant growth can at least be partially controlled. At present the most complete water control possible can be exercised over 18,000 acres of marsh on the Rockefeller Wildlife Refuge and 8,000 acres on the Marsh Island Wildlife Refuge. These acreages are completely surrounded by levees and under normal circumstances water conditions can be controlled. As yet, precise techniques have not been worked out as to the detailed manner in which each impoundment should be managed. Intensive research projects are now under way to work out the proper procedures but a great deal remains to be learned.

At present some small impoundments are being drained in order to encourage the production of the highly desirable marsh plants listed above. At the same time others will be maintained in a flooded condition in order to stimulate the production of widgeon grass and other aquatics.

change. All plants have a definite range of tolerance for salt water, and while the salinity is within a certain range only certain plants will grow, providing other conditions are favorable. Whenever the salinity goes above or below the survival range for excessive periods of time the plants occupying the site will disappear. Then another group of plants, whose salinity requirements have been met as a result of the change, will generally take over the site. Fresh, brackish and salt marshes all produce several good game food plants, but during the change over from one type to another, a marsh will often remain bare of vegetation until the invading plants have an opportunity to take over. When this happens, wildlife food and frequently cover are generally unavailable. Consequently, the animals depending on the area for food and cover, disappear. Experience in the coastal marsh region has shown that brackish marsh conditions are most productive for wildlife and by controlling salinities and water levels, maximum benefits can be obtained.

It has previously been demonstrated on private lands along the coast that water conditions can be partially stabilized through the installation of low water Wakefield weir type structures in the channel outlets that service the marshes. In tidewater areas daily currents sweep in and out of the marshes as tides rise and fall. Under such conditions the tidal ponds are generally dry during periods of low water and flooded out by water of variable and often high salinity during high tides. Very little, if any, widgeon grass is produced in the ponds under such conditions and the marsh types surrounding the ponds are often of inferior quality. Such plants as needle grass or black rush (Juncus sp.), oyster grass *(Spartina alterniflora)* and salt grass *(Distichlis spicata)* generally predominate in such marshes.

On the other hand brackish ponds completely surrounded by marsh and without connecting tidewater tributaries are nearly always highly productive of healthy growths of widgeon grass. In addition such ponds are nearly always surrounded by desirable marsh types such as three-cornered grass. Thousands of examples of this can be found at all points along the Gulf Coast as well as on the refuges.

In attempting to stabilize conditions in the tidewater marshes of the refuges a plan is now underway to install a large number of low water sills as mentioned above. Under this form of development, water levels, salinities, tidal action, turbidity and the many other factors influencing plant growth will be partially stabilized. This conversion of ecological factors should bring about a great increase in widgeon grass production in the tidewater ponds and an improved marsh type.

This type of marsh development is considered to be very sound and will be expected to bring about a much more attractive condition in the tidal areas for both fur bearing animals and waterfowl. Such ecological changes generally occur rather slowly and several years may pass before the results are finally obtained.

MARSH BURNING

A controlled burning program is conducted each year on the refuges lying in the coastal marsh region. The program usually begins in mid-fall, depending on the condition of vegetation, and extends until about March, varying with weather conditions and the beginning of bird nesting season. Past experience has shown that marsh burning removes dense stands of coarse vegetation and sets back plant succession, thereby encouraging the growth of better game food plants, particularly three-cornered grass. Three-cornered grass is well known as the choice food of geese and muskrat. When the desired vegetation is established, periodic burning is necessary in order to maintain the stand and prevent it from being replaced by a less desirable species. However, burning sometimes fails when other conditions, such as those mentioned above, are not favorable.

Fresh burns are especially attractive to blue and snow geese. In fact, such large concentrations frequently build up on new burns that the danger of an "eat out" arises. When this condition exists, the geese must be moved from the area in some

Controlled burning in the marsh to encourage the growth of good game food plants.

manner. This is usually accomplished by making another burn, then by preference they go to the new burn.

Once a marsh has burned it usually requires two years growth before the vegetation is dense enough to burn again. This varies with the species, and some grasses can be burned every year while others may require from 3 to 5 years growth.

Research studies are now underway to gather much needed information relative to marsh burning practices. At this time all new burns are being mapped and the burns dated in order that vegetative changes may be detected.

Mineral Development Control.

All oil and gas developments and geophysical operations conducted on the refuge areas are closely governed under rules and regulations promulgated by the State Mineral Board and the Louisiana Wild Life & Fisheries Commission. To date these activities have been conducted on both the Marsh Island Wildlife Refuge and the Rockefeller Wildlife Refuge.

It is the responsibility of the Refuge Division to see that no damages are incurred to wildlife or its habitat through the course of mineral developments. These activities have been closely supervised and the results might well serve as a much needed model to be followed in laying out gas or oil fields on private lands. As a whole these developments on the refuge areas have offered a number of advantages in properly managing the marshes. Drilling sites can be reached only through the excavation of canals and this work is the most closely supervised of all. Before any canal is dredged on an existing lease a representative of the oil company concerned meets with a member of the Refuge Division to work out a channel route and also an agreement to be approved by the Louisiana Wild Life & Fisheries Commission. In these agreements the Commission reserves the right to direct the manner in which the spoil from the canal is to be placed and a number of other terms that are generally necessary to protect the marshes against damage.

Since salt water intrusion is a major problem in the tide water marshes, spoils are placed in a manner necessary to serve as low lying levees. These levees are constructed to certain specifications and the oil company is expected to maintain them during the time that they are working in the area. By carefully selecting channel sites water control can usually be gained over vast areas of the marsh at no expense to the Commission. It is through this procedure that benefits in marsh management are often realized. In certain limited cases where it is necessary that water control structures be installed to protect the marshes the Commission is insistent that this be done and maintained at the expense of the company.

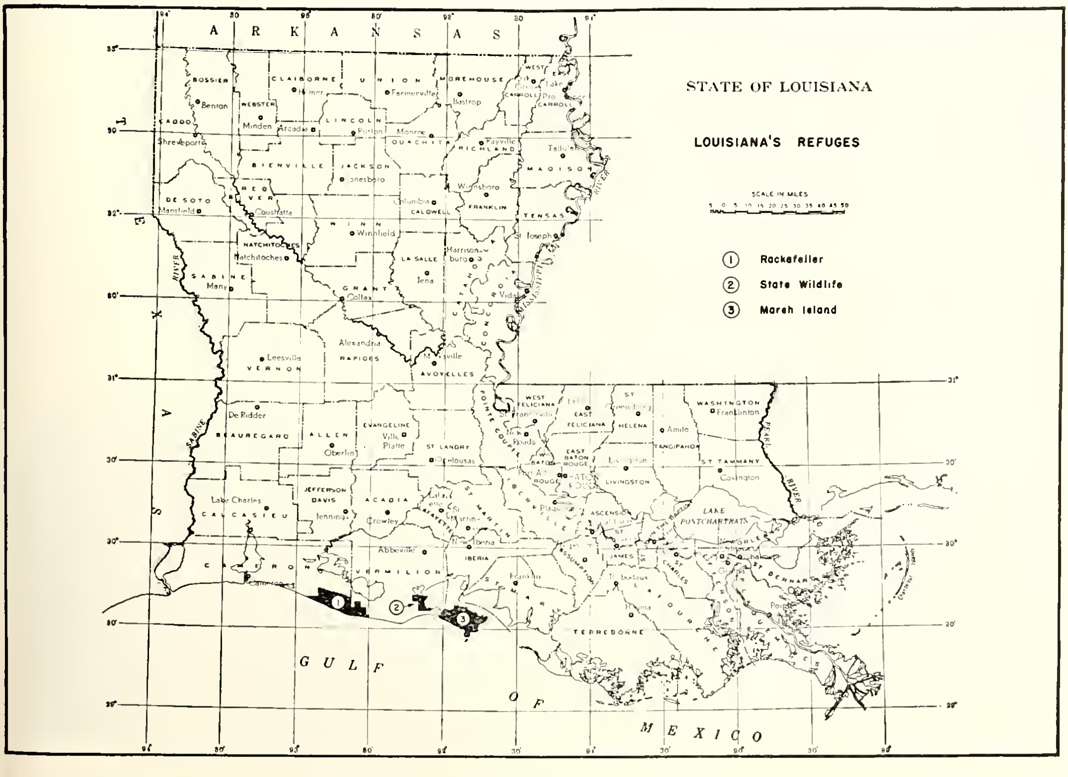
Wildlife Usage

The state-operated refuges in the Louisiana coastal marshes are highly attractive to many forms of wildlife. During 1957 the refuges wintered over one-quarter million ducks (see tables) and about 40 percent of the world's population of blue geese. In addition one of the few visiting flocks of Canada Geese wintered on Rockefeller Refuge. For several years coot numbers on the refuges declined steadily until only a limited number were present. After the completion of the fresh water impoundments, coots gradually returned and in 1957 almost 60,000 wintered on the refuges.

Mottled ducks, clapper rail and purple gallinules nest on the refuges and are frequently seen during summer months with their broods. Also green herons, Louisiana herons, boat-tailed grackles and willet are common nesters.

Many different gulls, terns, shorebirds, passeres, hawks, and herons are frequent visitors to the refuges. Also, white pelicans, bald eagles, grebes, ibis and mourning doves are frequently seen.

Fur bearers using the refuges include nutria, muskrat, rac-



One of the five Commission draglines at work repairing damaged levees.

coon, mink and otter. Nutria are the most numerous, at this time, but the population is only a small percentage of the number present in 1953 and 1954. This high population is not expected again. The refuges once supported thousands of muskrat, and in the early 1940's trappers removed almost one-quarter million animals annually. The population declined steadily from that time and today only a small number exists. However, conditions are now favorable for a buildup in numbers of muskrat and an increase is expected. Small colonies have appeared on both the State Wildlife and St. Tammany Refuges.

The coastal refuges support the few remaining concentrations of the Louisiana alligator. Because of some needless killing and uncontrolled harvest permitted by law, this valuable reptile has declined in numbers outside the refuges. The fresh water impoundments on the refuges have proven very attractive to alligators, and on a trip through one of these areas on a warm day a number can be seen. These reptiles are very important to nearly all forms of marsh wildlife during periods of drought. They maintain small deep pools of water throughout the summer and these ponds are heavily used by mammals and birds. Under extremely dry conditions these 'gator wells' provide the only available source of water. Practically all small forms of marsh life are used as food by alligators and this includes nutria, muskrat, blue crabs, snakes, turtles and many others.

Hurricane damage at Cameron.

Refuge restoration work.

WATER FOWL INVENTORY DATA

ROCKEFELLER REFUGE—SEPTEMBER 6, 1957—JANUARY 13, 1958

Date	Pintail	Mallard	Baldpate	Shoveller	Gadwall	Blue Winged Teal	Green Winged Teal	Black and Mottled Ducks	Scaup	Mergansers	Total Ducks	Blue and Snow Geese	Canada Geese	Coot
Sept. 6	1,000					20,000								
Sept. 24	750			1,000		15,000	100	275			21,275			1,000
Oct. 5	1,000			1,000		15,000	100	400			21,275			1,000
Oct. 16	1,000		500	2,000	500	20,000	1,250	300			17,400			2,000
Oct. 29	7,500	1,500	3,000	5,000	5,000	18,000	15,000	500			25,750			20,000
Nov. 20	7,500	7,500	18,000	10,000	25,000	15,000	15,000	1,000	500	200	99,700	45,000		35,000
Dec. 10	10,000	12,000	28,000	20,000	37,000	15,000	30,000	1,500	1,500	250	155,200	50,000		35,000
Jan. 6	15,000	14,000	29,000	25,000	37,000	12,000	25,000	1,500	2,000	250	160,750	40,000	150	30,000
Jan. 13	20,000	14,000	41,000	20,000	35,000	15,000	35,000	1,750	2,000	250	175,000	50,000	300	30,000

WATERFOWL INVENTORY DATA

MARSH ISLAND REFUGE—OCTOBER 5, 1957—FEBRUARY 21, 1958

Date	Mallard	Gadwall	Baldpate	Green Winged Teal	Blue Winged Teal	Shoveller	Pintail	Black and Mottled Ducks	Scaup	Total Ducks	Blue and Snow Geese	Coot
Oct. 5					500	100	200	200		1,000		1,500
Oct. 16		450	300	1,000	3,000	2,500	2,500	250		10,000	3,000	2,000
Oct. 29	500	1,000	500	1,500	4,500	6,000	5,500	250	250	25,000	41,000	3,500
Nov. 23	2,000	5,000	2,000	4,000	4,000	6,500	5,750	250	500	30,000	50,000	5,000
Dec. 9	5,000	10,000	3,500	7,000	4,500	9,000	6,000	250	1,000	46,250	90,000	10,000
Jan. 7	8,750	14,000	7,000	8,000	3,000	11,500	6,500	250	1,000	60,000	50,000	18,000
Jan. 13	12,000	14,000	8,000	11,750	3,000	12,000	8,000	250	1,500	70,250	30,000	20,000
Feb. 1	14,000	18,000	8,750	14,000	3,000	16,000	10,000	250	1,500	85,500	10,000	18,000
Feb. 21	15,000	18,000	8,750	14,000	3,000	18,500	8,000	250	1,500	87,000	4,000	14,000

*Blue Geese Comprise 95% of the Totals Listed.

WATERFOWL INVENTORY DATA

STATE WILDLIFE REFUGE—OCTOBER 5, 1957—FEBRUARY 21, 1958

Date	Mallard	Gadwall	Baldpate	Green Winged Teal	Blue Winged Teal	Shoveller	Pintail	Black and Mottled Ducks	Scaup	Total Ducks	Blue and Snow Geese	Coot
Oct. 5					150	50	100			350		200
Oct. 16		200	100	250	400	200	300	50		1,500	1,000	500
Oct. 29	100	1,000	600	800	600	800	550	50	50	4,500	9,000	800
Nov. 23	350	2,500	900	1,500	500	1,200	1,000	50	50	8,000	30,000	2,000
Dec. 9	1,000	2,800	1,000	1,800	500	1,600	1,200	50	50	10,000	30,000	2,000
Jan. 7	1,200	3,000	1,200	2,200	400	1,800	1,500	50	50	11,400	25,000	2,000
Jan. 13	1,500	3,200	1,200	2,400	500	2,000	1,800	50	50	12,700	20,000	1,500
Feb. 1	1,500	3,500	1,500	2,500	500	2,000	1,800	50	50	13,400	12,000	1,400
Feb. 21	1,600	3,500	1,500	2,500	600	2,200	2,000	50	50	14,000	8,000	600

PATROL AND PROTECTION

This is a routine but very necessary phase of properly managing the refuge areas. It is a job that goes on from sunrise to sunrise every day in the year. Although most people at work on the refuges are dragline operators, maintenance repairmen, or biologists, all employees are required to cope with any trespass problems that may arise. These individuals travel through the most remote sections of the refuges during the course of their routine work, providing frequent coverage against violations.

The equipment on hand for use in patrolling the refuges is the finest available. This includes six cabin boats equipped for overnight ventures, and three of these are equipped with radio equipment. Five mud boats, several outboard motor boats, and one radio equipped seaplane are also available for patrol purposes when needed. Excellent radio facilities are located at each headquarters site to provide communication with the boats working on patrol duty.

As a result of the well equipped force mentioned above the hunting of game species on the refuges has been nonexistent. The only troublesome form of violations occuring the past few years is that of alligator hunting at night. Due to inadequate laws these reptiles have been severely depleted in numbers over most of the coastal marshes. The Louisiana alligator provides the finest skin for finishing leather goods in the world, consequently the raw hides can easily be marketed for $3.00 per linear foot. Because of rigid protection the refuges are carrying extremely high alligator populations and this is, of course, an attractive incentive to commercial hunters. In one short foray at 2 A. M. an alligator hunter can easily pick up 3 or 4 gators worth $100.00, provided he can complete the venture without being caught. During the past few years Louisiana's alligator harvest has dropped by over 65%, indicating that few are to be found in the areas where they may be legally hunted.

In combatting this problem frequent patrols are made through the marshes at night by small boats. Also cabin boats are stationed overnight at different points over the marshes.

MARSH ISLAND REFUGE

Robert H. Chabreck

Biologist

Work began in January 1958 on a boat house for the Marsh Island refuge. This boat house will be situated to the rear of the main camp and will protect boats from weather, when not in use, and will facilitate maintenance. It will be constructed to a dimension of 50 ft. x 60 ft. with all metal materials mounted on a concrete cap supported by 40 ft. long piling. Plans and specifications were prepared by the Department of Public Works and the job is being carried out under a contract.

A work shop is included in the rear of the boat house for minor repair and construction work. The 110-volt power plant currently in use to supply electrictiy to the headquarters building will be placed in the boat house on a specially constructed platform above storm tide level. Plans are also being made for construction of a boat house on the State Wild Life Refuge and a building site has been prepared.

Water Control Structures

Material has been ordered for the construction of weirs in strategic drainage systems. Building sites were located by a geological investigation. The structures should restrict saltwater intrusion and favor the growth of more desirable game food plants on an area of approximately 6,300 acres. Periodic measurements will be made of vegetation with line transects to determine the actual effects of the structures. Also data will be collected on the physical and chemical properties of the water behind each structure. An identical procedure will be followed on a control area, where no improvements are made, and the final results of both areas compared.

Impoundment

Work was completed on an 8000-acre impoundment on the Marsh Island Refuge during the fall of 1956. The impoundment was formed by constructing a levee around the southwestern portion of the island. Plans and specifications for the job were prepared by the Department of Public Works and the levee constructed under a contract. During the winters of 1956 and 1957 this area supported large concentrations of ducks and coots. Ducks commonly seen included mallard, pintail, gadwall, baldpate, shoveller, and blue-winged teal. During the summer rails and gallinules used the impoundment extensively for nesting. In construction, a canal was dug and the spoil used for levees. The canal was placed inside the impoundment to avoid salt water intrusion and has proven especially attractive to alligators.

Water Control Gates

In the original design for the Marsh Island impoundment no plans were made for water level manipulation. After completion it became apparent that some device to lower the water level should be installed. With cooperation of the Department of Public Works plans were drawn up for the installation of 5 water control gates. These structures will be all metal, of culvert design, with a width of 72 inches. The contract for this work has been let and construction started. The gates will be placed along the levee at selected points. Water will be removed from the area during the summer months, after waterfowl have left, in order to stimulate plant growth. Then, during the fall, prior to the arrival of waterfowl, the gates will be closed and enough water held to attract waterfowl.

Bulkhead Around Headquarters

A bulkhead will be constructed at Marsh Island in order to protect the headquarters site from wave erosion produced by boat traffic in Bird Island Bayou. This will require 750 ft. of sheet piling along that portion of the site bordering Bird Island Bayou. The headquarters site is actually an island composed of 2.4 acres with an erosion rate of about 5 feet per year. All construction work on this project will be done by refuge personnel. Plans and specifications are now being prepared by the Department of Public Works.

Cattle Study

A study is being conducted on the Marsh Island Refuge to determine the effects of cattle on marsh plant and animal life. Observations to date by many persons have suggested that controlled cattle grazing in a marsh is actually beneficial to wildlife. However, no detailed studies have been conducted to determine the extent of this relationship. At present 17 cattle exclosures are being constructed and placed in different vegetative types on the cattle range. The exclosures are 30 feet square and constructed with creosote posts and 4 strands of barbed wire. Vegetation measurements will be made twice each year, once before the cattle arrive and again when they are removed. Sampling methods include line transect and plots, plus measurements of seed production on key species inside and outside each exclosure.

Clearing Waterways

As a result of "Hurricane Audrey" several necessary navigation canals were blocked with debris. In order to have all-weather access to all parts of the island for patrol and other refuge purposes, cleaning the channels was necessary. This debris has been removed by means of the refuge dragline.

Muskrat Transplanting

Muskrat on Marsh Island were beginning to appear again in numbers when hurricane "Audrey" struck. Careful ground and aerial searches as late as 8 months after the storm revealed the complete absence of this once very common animal.

Three-cornered grass, the choice muskrat food, is abundant throughout the central portion of the refuge after being almost absent for several years. Long range outlooks indicate that habitat conditions for muskrat will continue to improve. In order to hasten the re-establishment of muskrat, 400 live

An aerial view of a refuge installation following the visit of Hurricane Audrey.

animals were captured in rice field levees near Abbeville and released on Marsh Island. Careful records have been kept on releases and frequent inspections are being made to determine the success of this operation. This work is being done through the efforts of the Fur Division.

STATE WILDLIFE REFUGE

Robert H. Chabreck

Air Strip Extension

Formerly the refuge maintained a 900-foot air strip; however, the installation of a 140-foot radio tower at the refuge headquarters necessitated an extension of the runway. By extending an existing canal along the runway with a refuge dragline the air strip was lengthened by 300 feet. A small tractor was purchased and will be used to cut grass and brush around the camp and on the air strip.

Trapping Camps

Present conditions indicate a high muskrat population on the refuge within the next few years. Past experience has shown that unless the population is kept below a certain level, serious damage results through "eat outs". To keep the muskrat population within reasonable limits surplus animals must be removed. Trapping camps are being built in certain areas for persons employed in harvesting the surplus animals.

S. L. I. Biological Laboratory

A biological laboratory, under construction by Southwestern Louisiana Institute, is nearing completion. The building site was leased to S. L. I. and through a cooperative agreement an access canal was excavated by refuge personnel with a refuge dragline. The canal is approximately 800 feet long and 40 feet wide with a boat turning basin at the end. The building is to be used for research on marine life and fur bearing animals, and is also equipped with teaching facilities.

Boat Ways

Since boats are the only means of transportation on Marsh Island and State Wild Life Refuges, it is important that they be kept in perfect working condition. Most navigation routes to the refuges and on the refuges are very shallow, and during low tides oyster reefs present a problem even to persons most familiar with the areas. Consequently, boat repair and maintenance are frequent jobs which cannot be delayed. In order to facilitate boat repair and maintenance, ways will be constructed at both refuges. Building sites have been prepared near the refuge headquarters and construction will begin on both in the near future. The cost of boat maintenance will be appreciably reduced and the time that boats are out of service will be minimized. The boat ways will be constructed by refuge personnel.

Nutria Exclosures

Since their original installation vegetative measurements have been made annually in nutria exclosures on the refuges. In addition, measurements were made in vegetation on plots outside each exclosure. The nutria population was reduced considerably as a result of the hurricane, so it will be interesting to see how the vegetation responds. This study will be continued.

Aerial Photographs

Aerial photographs were taken of each refuge and a mosaic produced with a scale of 1 inch to 1000 feet. Two prints were made of each photograph and a copy mounted at each refuge headquarters. The photographs have proven very satisfactory in locating and tracing small inaccessible lakes and bayous. Entire drainages of major bayous can be traced, transportation routes checked and the boundaries of vegetative types located.

ROCKEFELLER WILDLIFE REFUGE

Allen Ensminger

Reconstruction of Facilities

Following hurricane "Audrey" on June 27, 1957, rebuilding efforts were started within a few days. This work, however, was hindered greatly by the lack of access roads, water and food supplies, housing facilities and communications. Since all of the employees assigned to this refuge live in the area they were confronted with staggering personal problems as a result of losing their homes and belongings. Personnel from the Commission's wharf at New Orleans were called in for assistance at Rockefeller for a period of 3 or 4 months.

East End Headquarters

Prior to "Audrey" the East End Headquarters needed considerable repairs and following the storm only a shell of the building remained. By mid-October this building was completely restored and in excellent condition. In effecting the repairs the roof, porches, floors, fixtures, outside covering, plumbing, screens, windows and window frames, inside covering, and sills had to be replaced. All repair expenditures were compensated for by insurance.

West End Headquarters

The West End Headquarters building survived the storm also since it was originally constructed on pilings. However, it was damaged in a manner equal to that mentioned above for the East End building. Plans and specifications were drawn up in a form necessary to completely restore the building and bids were solicited by the Division of Administration for this repair job. Two advertising periods proved necessary, apparently because many of the contractors were reluctant to work in the area or were too busy on other jobs. At the end of the second advertising period three bids were received and the contract awarded to the low bidder.

This restoration and repair job was completed during February in a very favorable fashion by the contractor. The costs were compensated for by insurance.

Boat House and Work Shop

This 210 ft. x 60 ft. metal building was severely damaged by the hurricane. A large percentage of the metal covering over the sides and part of the roof was carried away. All doors, electrical fixtures, the inside office and boat bays were also demolished. All repairs have now been completed and the building has been restored to its original condition.

The boat bays and the inside office were restored by refuge personnel while the remainder of the building was repaired under a contract. All expenditures were covered by insurance.

Main Headquarters

The four relatively new buildings located here were demolished beyond repair by the storm. One of these completely collapsed 50 ft. from its foundation, one was swept away and partially collapsed one-half mile away from its foundation, another remained on its foundation but was damaged beyond repair, the fourth was swept from its foundation and partially collapsed.

After much study a decision was made to sell the remains of these buildings since they could not be economically repaired. This sale was widely advertised by the Division of Administration for a period of over 20 days and the buildings were sold to the high bidders. Full insurance settlements were received and the salvage remained the property of the "*State*", hence the necessity for the sale.

Plans and specifications are now being drawn up for the replacement of these buildings by the Department of Public Works. To a degree appearance will be sacrificed for practicality since the new buildings will be placed on piling well above any future storm driven water levels. Buildings constructed in this manner can be expected to survive any hurricane that may occur in the future as evidenced by the fact that similar houses remained standing after "Audrey". When constructed these buildings will also provide a haven during future storms for any employees or local citizens who may be trapped in the area.

Radio Facilities

The 300 ft. radio tower destroyed by "Audrey" has since been completely replaced along with the transmitter and receiver. The tower was restored at no cost to the State since it was originally guaranteed against winds up to 120 m.p.h. The highest recorded wind was 105 m.p.h. but the tower snapped in several places nevertheless.

Communications at Rockefeller are again in excellent condition at this time.

Levee Repair

Over 100 miles of levees are in service at the Rockefeller Wildlife Refuge for water control purposes and the prevention of salt water intrusion. As a result of the storm these levees were badly eroded for miles on end and broken through at a number of points. Very few of these levees exceed 6 ft. in elevation above marsh level, however, the crown widths average 10 ft. to 14 ft. and the base widths average 50 ft. to 65 ft.

The restoration of these levees is a monumental task and at this time 4 draglines are being used by the Refuge Division in repair work. The objectives set forth in regard to this job is to dress and repair every foot of each levee on the Rockefeller Wildlife Refuge. Considerable progress has already been made in carrying out this effort.

Two oil companies are charged with the maintenance of a number of levees on the Refuge and they have been contacted in order that those levees may be repaired also.

Repair to Water Control Structures

The three concrete structures remained intact during the storm, however, the marsh material around the end of the structures washed out during the hurricane. This damage has been successfully repaired at all points by dragline except at the Rollover Bayou structure. Here several attempts have been made to restore the damage by replacing the marsh material. Each time this repair work has eroded away due to the undercutting effect of the current along the bank near the structure. Surveys have been made of the problem by the Department of Public Works and plans and specifications necessary to correct the existing condition are being prepared.

Many of the walkways leading to the small gated structures through the levees were washed away by "Audrey" and while several have been replaced, a number are still in need of repair.

Replacement and Repair of Equipment

At the time of the storm two draglines, owned and operated by the Refuge Division, were at work dressing levees on Rockefeller. These machines were virtually submerged by salt water and sand deposits were found in the engines and gears. Both the cabs and booms were battered and bent by the storm.

With considerable effort these draglines were removed from the marsh and sent to Baton Rouge for repairs. This necessitated a complete strip down of both machines from the tip of the boom to the base of the tracks. This repair job was completed in a favorable fashion and the draglines were immediately returned to Rockefeller for work.

The repair bill submitted for restoring these machines was compensated for by insurance.

Since "Audrey" one new dragline has been purchased and another rented on a temporary basis from the State Parks Commission for a total of four currently at work on Rockefeller.

Two track type marsh buggies were located at Rockefeller's prior to "Audrey". They were in sad need of repair and the battering received during the storm virtually finished them off.

Both were recovered and sent in for repairs but it was found that only the transmissions would be usable. Two new marsh buggies were constructed using the two old transmissions only. This included new engines, aluminum tracks, pontoons, gears, chains, and radiators. A full insurance settlement was received and the new marsh buggies are now at work replacing the 50 miles of refuge boundary markers carried away by "Audrey."

One 38 ft. gasoline driven cabin cruiser, one 20 ft. Chris-Craft, 5 mud boats and 1 outboard hull were demolished by hurricane "Audrey". One 50 ft. diesel powered cabin boat and 5 mud boats were severely damaged during the storm. All losses except repair of three mud boats, the loss of one mud boat and one outboard hull were compensated for in full by insurance.

The 38 ft. cabin cruiser was replaced by a craft of similar hull size and design except that it is powered by two 671 diesel engines. For patrol purposes this boat will have a number of excellent qualities including high speed, facilities for overnight trips, radio communication with the central headquarters, very low operation and maintenance costs, and safety. The Chris-Craft mentioned above has not as yet been replaced. All of the 5 repairable mud boats have been completely rebuilt and restored to duty.

One 50 ft. cabin boat "Muskrat" was stranded in a wooded area one-half mile away from water by the storm. Several weeks passed before it was finally recovered and returned to water by means of two draglines. After almost two months in a shipyard at New Orleans this boat was returned to service.

Two spud barges were stranded high and dry at Rockefeller and another drifted 15 miles during the hurricane. All of these barges have been recovered and returned to duty.

Two pick-up trucks and two station wagons were destroyed by hurricane "Audrey." The loss of these vehicles was compensated for by insurance and they have since been replaced with three pick-up trucks and one station wagon.

One tractor completely submerged by salt water was traded in on a replacement.

Marsh Development

Marsh improvements through new development work has been limited in scope recently because of the tremendous number of necessary restoration, recovery, and maintenance jobs.

Lake No. 1

This 1,000 acre impoundment on Rockefeller has been subdivided by means of a refuge dragline since the smaller units can be more properly managed for the production of units will be maintained in a semi-dry condition during the wild millet and other seed producing annuals. These smaller start of the growing season in order to provide maximum production.

Experimental Area

The experimental area, a 146 acre impoundment is located at the main headquarters. A fixed pump is available to remove the water from this area for the purpose mentioned above. At this time the experimental area is bare of all vegetation except for a few isolated growths of wiregrass. It should re-vegetate during the coming growing season and be available for use by waterfowl during the fall and winter of 1958.

Deep Lake Area

Partial water control has been gained over 4000 acres of marsh between Joseph Harbor and Deep Lake through the construction of a levee from the south shore of Deep Lake to the old Royalite Well in Sec. 30, T 16-S, R 3-W. This water control will partially prohibit rapid tidal and salinity changes and will stabilize water levels over a large portion of the marsh encircled by levees. The ponds in the area are expected to produce good stands of widgeon grass during 1958 and attract large numbers of ducks in the fall and winter. Some circulation of water from high tide will penetrate over the area and reduce the possibility of stagnation.

The levee mentioned above was constructed by an oil company during the excavation of an access canal to a drilling site. Placement of all spoil from the channel used to form the levee was directed by the Refuge Division in order to derive maximum benefits. This type of water control was gained at no expense to the Commission other than supervision.

Lake No. 15 Area

Within the next few months water control will be gained over 1500 acres of tidewater marsh near Rollover Bayou. In addition Lake No. 15 will be subdivided into two separate areas of equal size.

Permission has been granted to Tennessee Gas Transmission Company to install one 16-inch pipeline across the eastern end of the Refuge, subject to the condition that they place all spoil from the excavation work at the direction of the Refuge Division. They also agreed to install low water bulkheads where necessary in all channel outlets. This work will be directed in a manner necessary to gain water control over 1500 acres of marsh between the east property line canal and the pipeline.

Water Control Weirs

Materials and supplies necessary to construct several small low water Wakefield type weirs are now on order. Plans and specifications for these control structures have been prepared and they will be installed by means of Refuge personnel and equipment. The benefits to be realized from this type of development work are described in other sections of this report.

East End Headquarters

Plans and specifications are now being prepared by the Department of Public Works for a bulkhead to be placed around the East End Headquarters of Rockefeller. The fill and roadway here is rapidly eroding away and this corrective action is considered necessary. A sizeable fill has already been made here to stabilize the roadway in preparation for the installation of the bulkhead.

Boat Opening

Plans and specifications are now being prepared by the Department of Public Works for a boat opening and water control structure to be installed in the property line canal near the East End Headquarters site. When completed this very necessary job will be the largest single undertaking constructed thus far on the Refuge.

Under existing conditions it is necessary to close the canal by means of an earthen plug for long periods during the year in order to prevent the direct intrusion of salt water from the Gulf into the refuge and eventually into the rice fields. In view of the seriousness of this condition the matter has been discussed on different occasions with representatives of the Mermentau River Basin Association and the Department of Public Works. During the time that the earthen plug is in place the canal cannot be traveled and the eastern two-thirds of the refuge is divorced from the boat house. This prohibits the movement of barges and draglines as well through to the eastern portion of the refuge, thereby complicating the work schedule. Of primary consideration also is the drainage factor involved. When the earthen plug is in place drainage from a part of the Grand Chenier ridge complex is partly blocked and this greatly adds to the existing problem. During periods of heavy rainfall it is necessary to remove the dam in order to permit drainage.

At this time the supply of earth necessary to close the canal has been almost exhausted and in order to alleviate this and the problem mentioned above it will be necessary to install a large semi-lock type structure. This design will be made in a manner necessary to permit drainage, prohibit salt water intrusion, and permit the passage of draglines or barges, as well as boats.

OYSTERS WATER BOTTOMS AND SEAFOODS DIVISION

JAMES N. McCONNELL

Chief

At the close of business June 15, 1956, Director Ernest S. Clements merged the Commercial Seafoods division with the Division of Oysters and Water Bottoms, forming the presently titled Oysters, Water Bottoms and Seafoods division. This action by Director Clements was ratified by the Louisiana Wild Life and Fisheries Commission on October 16, 1956.

In reviewing the activities of this division during the past two years it will be noted that special efforts are being made to determine the reasons for the continued reduction of both the oyster and shrimp industries and to find ways and means to eliminate or at least alleviate the difficulties now facing both of these industries. Upon reviewing the detailed biological reports of Dr. Lyle St. Amant, chief oyster biologist, and Percy Viosca, Jr., chief shrimp biologist, certain salient facts seem to stand out as prime factors in summing up the problems presently facing both the oyster and shrimp industries. We will now attempt to give a short resumé of these problems.

Natural Causes

1. Lack of fresh water since 1953 has resulted in lowering salinities in all our coastal areas and bringing about conditions more suitable for depredations from "*Thais*", the oyster drill, and *Dermocystidium marinum*, a fungus disease. Both are considered as highly detrimental to oyster life. The white shrimp (*Penaus setiferus*) is particularly effected by lack of river water and higher salinities.
2. Effects of hurricanes, short term temperature changes, and long hot summers have a deleterious effect on oysters. Hurricanes and heavy freezes affect shrimp.

Man-Made Causes

One does not have to be an expert to fly over our coast and see how drastically industrial expansion has changed the characteristics and ecology of the coast. It is all too obvious that large areas, once oyster producing, have been physically usurped by oil fields. Canals and spoils have changed currents, caused silting of bays from normal sediment and have changed the mean salinities of areas. Pollution from industry is still prevalent and accumulative. While admittedly no one has brought proof to date which indicates that oil or bleedwater is an immediate killer of oysters, this does not lessen the fact that it is not desirable to grow oysters in oil-polluted areas nor does it alleviate the fact that oysters which absorb an oily taste from pollution are totally unfit for the market.

JAMES N. McCONNELL

Silting a Serious Problem

The effect of diversion of currents, changes in current velocity, and the inadvertent formation of settling basins by indiscriminate placing of spoil banks with relationship to silting create a serious problem. It is obvious that silting will greatly increase from the dropping of the normal silt load if currents stop or are slowed. The oysterman is all too well aware of this fact and selects a bed site well swept by currents in order to prevent silting. In many cases dredging and spoil placement well away from a bed will so divert currents that the normal silt load in the water will settle and cover the bed. There are no two better examples of such drastic silting than Lake Grande Ecaille and Bay Long (Ronquille). Both of these bays have become so filled that a boat cannot operate out of marked channels.

Geophysical Operations

Geophysical activity has been somewhat absolved of guilt in oyster mortalities on the basis that experimental tests of blast effects fail to show any definite mortality trend, except in close proximity to the shotpoint. Such tests were designed to test the blast effect and possible later effects only. These experiments did not take into consideration the possible effect on oysters lying on soft mud bottom, the damage that can be and is done in shallow mud bottom bays by boats and marsh buggies used in seismic work, and the carelessness of some seismic crews.

Bayou Lamoque Fresh Water Diversion Project

In September 1956 a controlled spillway was completed at the junction of Bayou La Moque and the Mississippi River in Plaquemines Parish, east of the river. The cost of these four 10 ft. x 10 ft. concrete boxes with control gates amounted to $170,488.00. A canal leading to the coastal bays was completed October 31st, 1956, at a cost of $52,100.37, paid for jointly by the State and Plaquemines Parish.

After six months of operation it became evident that it was impossible to open these gates more than 3 feet at high river due to scouring at the rear of the structure, and it was also found that it would be necessary to considerably increase the size of the canal leading to the sound.

From February 1st to December 31st, 1957, 500,000 acre feet of water was discharged through this structure.

Although these gates have only been operating to less than 1/3 of capacity at higher river, much good has been accomplished by this introduction of river water to the American Bay section. Yield from oysters obtained from this area increased 100 per cent, and a considerable increase in spatfall was noted.

This Department is requesting the Department of Public Works for a cost estimate to enable this structure to operate at full capacity, thus furnishing additional river water so badly needed for increased oyster production in this section.

Flood Control

Another of the man-made problems that has seriously effected both the oyster and shrimp industries has been the flood control program carried on by the U. S. Engineers during the past thirty years.

Impounding of waters in the upper river areas and diversion of waters from the Mississippi to the Atchafalaya Floodway have helped considerably to lessen the flow of Mississippi River water below New Orleans.

A meeting held at the office of the District Engineer, New Orleans, on August 9th, 1957, attended by the writer, several members of this Department together with representatives of the U. S. Fish and Wild Life Service, and personnel from the District Engineers Office, relative to introduction of fresh water to the marshes from the Mississippi River below New Orleans, concluded in the following:

a. Delineate areas where water is to be introduced.
b. Determine the amount of water required.
c. Indicate period or periods during which discharges would be required.
d. Determine benefits in monetary terms for each area into which waters are introduced.

These requirements were discussed at the office of the Louisiana Wild Life and Fisheries Commission on August 9th, and 12th, 1957. In attendance at this discussion were the Chiefs of the Oysters, Water Bottoms and Seafoods, Refuge and Fur Divisions and members of their staffs. On August 12th members of the Louisiana State Board of Health participated in the discussion.

Mississippi River waters below New Orleans are heavily polluted and the possibility of contaminating oysters was considered. It was concluded that no major difficulties were anticipated because a major portion of the areas affected by discharge of Mississippi River water would be utilized as a source of seed oysters, which would be planted in "clean" areas. Harvest areas would have the waters shut off prior to the harvesting season so that the oysters would have time to clean themselves. Oyster areas are subject to continual inspection by the State Board of Health and any areas found contaminated would be subject to harvest restrictions.

Tentative selection of four areas were made and outlined on a map.

1. *Barataria Bay.* Salinities are too high throughout most of the year to provide conditions satisfactory for oyster production. Reduction of salinities from 20,000 ppm of dissolved solids, as they now exist, to 10,000-14,000 ppm during early spring, would provide optimum conditions for "spat" set and prevent the oyster drill *(Thais)* from reproducing. Maintaining low salinities throughout hot weather will greatly reduce oyster mortality and prevent predation by the oyster drill. Fresh water should be introduced into the northern part of Barataria Bay in the latitude of Bay Chene Fleurie from the vicinity of Wilkinson Canal on the west to Bay Batiste on the east.
2. *River Aux Chenes* (Oak River). This area lies north and east of the Mississippi River between that stream and Bayou Terre Aux Boeufs, in Plaquemines Parish east of the Mississippi River. Waters should be introduced into the River Aux Chenes system between Poverty Point and Davant Wharf.
3. *Grand Bayou.* This area lies in Plaquemines Parish southeast of Barataria Bay between the Mississippi River on the north and the Gulf of Mexico on the south. Waters should be introduced between Port Sulphur and Empire on the west bank of the Mississippi River in Plaquemines Parish.
4. *Lake Lery—Grand Lake.* This area lies southeast of New Orleans between the Mississippi River and the River Aux Chene area and is bounded on the east by the Bayou Terre Aux Boeufs ridge. Waters introduced between Caenarvon and Bertrandville would benefit waterfowl and muskrat marsh. The degree to which oyster producing areas would be affected is open to speculation.

Benefits to oyster production are predicated on the degree of success achieved in reducing salinities over the critical period of the spat set and during summer months. Benefits to areas 1, 2 and 3 are assigned at from $1,000,000 to $2,000,000 annually, based on preliminary estimates.

Structures to admit water from the Mississippi River must be provided with controls, and authority for their operation vested in the Louisiana Wild Life and Fisheries Commission except in cases of emergency.

In general, a number of small structures rather than a few large ones would be desirable. An exception to this is the Barataria Bay area where the Louisiana Wild Life and Fisheries Commission desires the first structure to be built of sufficient size to control salinities in the northern half of Barataria Bay.

On August 13th, 1957 this material was discussed at the U. S. District Engineer's Office, New Orleans, Louisiana. The engineer handling this phase of the work agreed to make preliminary inquiries regarding design and location of the structure. In an attempt to expedite the work, gross estimates were made of water needed to achieve the desired dilution in Barataria Bay.

From the discussion it is evident that there is an immediate need for an estimate of the amount of discharge required to achieve desired dilutions so that the U. S. Army Engineers can proceed with design and estimate of costs for water controlled structures.

The U. S. Engineers also desire a breakdown of benefits by each area under consideration in order to derive cost-benefits ratios. Method of arriving at anticipated benefits should be explained in sufficient detail so that it can be understood by those not familiar with the oyster industry.

Presently the material, requested by the U. S. Engineers is being gathered so that this most important work can proceed with as little delay as possible.

Decline in Production of Both Oysters and Shrimp During the Past Two Years

When reviewing the annual production figures of both oysters and shrimp for the last number of years it becomes immediately apparent that the supply of both of these most popular and important seafoods is diminishing rapidly.

PRODUCTION SHRIMP (HEADS ON)

Year	Bbls. (210 Lbs. Per Bbl.)
1952	398,952.4
1953	437,340.5
1954	451,646.7
1955	365,542.3
1956	318,130.3
1957	181,061.1

FRESH WATER FISH PRODUCTION

July 1, 1955—June 30, 1956	13,735,219 lbs.
July 1, 1956—June 30, 1957	11,384,874 lbs.

SALT WATER FISH PRODUCTION

July 1, 1955—June 30, 1956	9,392,805 lbs.
July 1, 1956—June 30, 1957	11,314,995 lbs.

BABY GREEN TURTLES

1956-1957	1,497,472

REPORT OF COLLECTIONS (FISCAL YEAR)

	1955-56	1956-57
Bedding Ground Rentals	$ 47,379.00	$ 48,463.00
Interest on Notes	113.81	....
Privilege Tax	15,601.85	16,578.38
Tonnage Licenses	1,850.00	1,441.50
Dredging Licenses	10,850.00	9,600.00
Resale, Shop	920.00	985.00
Transfer Fees	37.00	18.00
Shells	491,106.21	628,060.86
Sand	1,646.45	5,651.00
Gravel	....	6,081.75
Survey Fees	9,863.00	8,611.50
	$ 579,367.32	$ 725,490.99

REPORT OF PRODUCTION (CALENDAR YEAR)

Total Barrels of Oysters Taken from Louisiana Waters

	1956	1957
Terrebonne	59,220.00	32,099.50
Lafourche	19,356.50	37,021.50
Plaquemines	167,911.50	136,462.50
Jefferson	90,284.00	8,848.00
St. Bernard	330,799.45	270,800.55
	669,571.45	485,232.05

Total Cubic Yards of Sand, Shells and Gravel Taken from Louisiana Waters

	1956	1957
Sand	84,622.94	134,024.87
Oyster shells	2,287,129.55	2,256,664.88
Clam shells	2,701,362.32	3,994,117.85
Gravel	263.25	40,150.00

Seafood Industrial Conference

At the regular monthly meeting of the Louisiana Wild Life and Fisheries Commission held in New Orleans, November 25th and 26th, 1957, after hearing numerous complaints from the Louisiana Oyster Dealers and Growers Association, it was suggested by the Commission Chairman and Attorney, that a conference be held with a committee from the Mineral Board, a committee from the Wild Life and Fisheries Commission, together with representatives from all other interested groups to gather all pertinent information on the problems involved, after which a conference was to be arranged between the two committees in an attempt to minimize these problems.

On March 14th, 1957 such a conference was held at the Monteleone Hotel in New Orleans. At this conference, attended by more than two hundred and twenty-five interested parties, statements were made by representatives of the industries, and March 24th was selected as the date when the two committees would further discuss the problems at the Wild Life and Fisheries Commission office in New Orleans.

Coastal Waste Control

Because of the steadily increasing mineral production, a special Coastal Waste Control section is now operating in an attempt to enforce the Louisiana Stream Control Commission regulations. Under an opinion rendered by the State Attorney General, the Louisiana Wild Life and Fisheries Commission was declared the enforcement agency for the above regulations.

During the past year a new boat has been built at a total cost of $19,000.00 and placed in this service. The crew of this boat consists of a competent Coastal Waste Inspector and a Boat Captain. The area supposed to be covered by this crew reaches from the Atchafalaya Bay in the west to the mouth of the Mississippi River and up the east side of the river to New Orleans.

We presently have no facilities available to properly patrol the area from the eastern shore of the Atchafalaya Bay to the Texas State line. Because of the vast increase in mineral production in our coastal areas it can be readily seen that with only this one crew operating we are barely able to scratch the surface in enforcing stream control regulations.

During the coming year every effort will be made to find ways and means to place two more boats and crews into this most essential service. Should three crews become available, one would patrol from the Texas line to the eastern end of the Atchafalaya Bay, another from the Atchafalaya Bay eastward to the mouth of the Mississippi, and a third crew would cover the area east of the Mississippi River from it's mouth to New Orleans. Such coverage of our coast line would greatly reduce the number of pollution complaints we now receive.

The Department planes render valuable assistance in locating pollution, and many aerial surveys are made over our coastline to locate oil spillage and other violations of Stream Control Commission regulations.

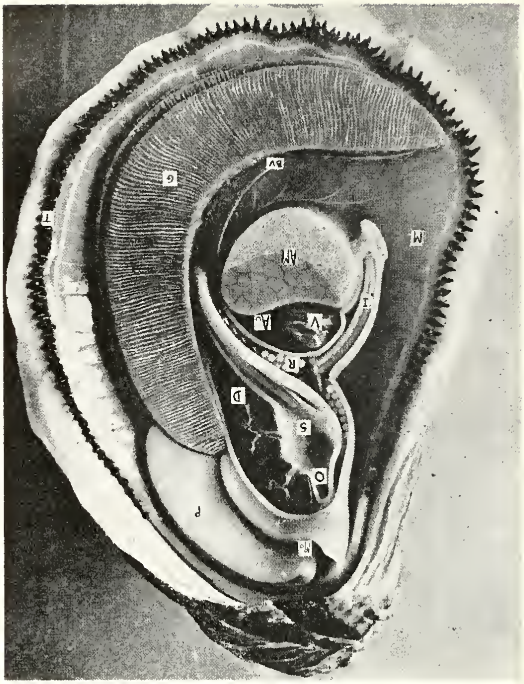
Shell Planting

This Division (as authorized by law) requires all canneries removing oysters out of the State of Louisiana to return to the water bottoms of Louisiana 20 per cent of the shells so removed. Such shells are returned without cost to the State and are bedded at the locations selected and the planting is supervised by this Division. These shells are used as "cultch" on which the young oyster "set" attaches itself. In the selected areas for such plantings we expect to average from three to four legal size oysters for each shell planted after a growing period of approximately two years.

During May 1956 approximately 20,000 barrels of shells from Mississippi canneries were planted in Black Bay (Nigger Lake). This planting was eminently successful and is fully described by Dr. St. Amant in his biological report.

An additional 30,482 barrels were planted in Mississippi Sound between Petit Pass on the west and Nine Mile Bayou on the east. An excellent "catch" was obtained from this planting. However from causes presently unknown, approximately 50 per cent of these oysters died after attaining a length of nearly two inches.

During May 1957, 45,563 barrels of shells were returned to Louisiana waters by Mississippi canneries and were bedded in Mississippi Sound on carefully selected bottoms between Nine Mile Bayou on the west and Three Mile Bayou on the east. Recently a survey was made of this planting and a very good "set" was noted. It is believed that these young oysters will reach maturity without undue losses.



Oyster partly dissected to show important structures. The right shell and mantle have been removed, exposing: AM, abductor muscle; AU, auricle of heart; BV, blood vessel draining gills; D, digestive gland; I, intestine; M, mantle; Mo, mouth; O, oesophagus; P, labial palps ("lips"); R, reproductive organ or gonad; S, stomach; T, tenacle on mantle edge; V, ventricle of heart.

Extension of Seismic Restrictions

In September, 1955 the Mineral Board and the Wild Life and Fisheries Commission placed all seismic operations carried on in highly productive oyster areas under special rules and restrictions which were to last for a period of eighteen months ending March 31st, 1957. During the eighteen month period it was to be determined if the new rules resulted in (1) better control of seismic operations, (2) less damage to oyster areas and a reduction in complaints, and (3) allow time for research to determine the effects of seismic operations on oysters and oyster beds. At the March 1957 meeting of the Wild Life and Fisheries Commission, the following was recommended:

The thirty-day delay between the time of application and the issuance of the permit is a most important regulation. This delay provides time to prepare maps, study proposed shot line routes, consult with oyster fishermen who have leases in the area and make any biological studies prior to the shooting.

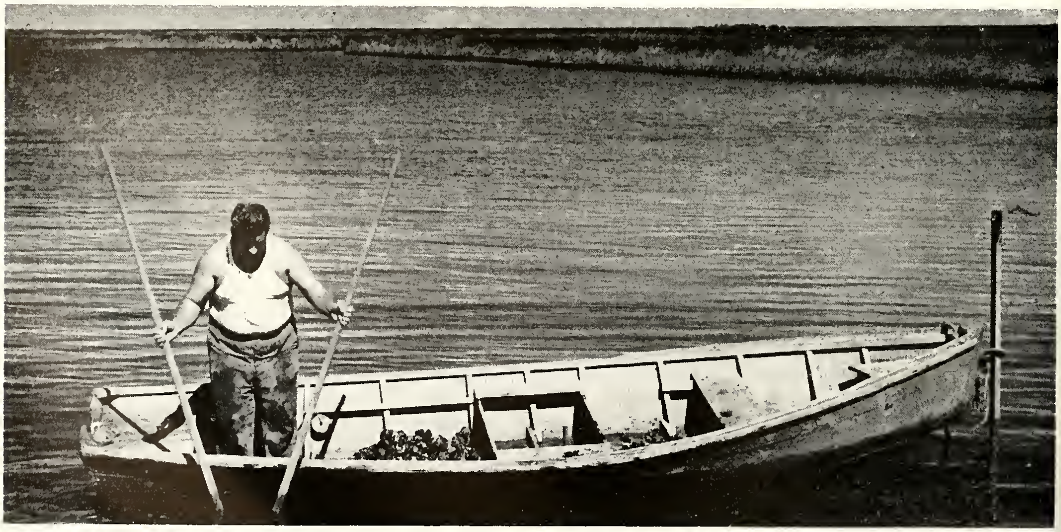
Next in importance are accurate maps of proposed shot lines and oyster leases in the area because without such data little control of seismic operations can be expected.

Maintaining all shooting at least 500 feet from the border of any oyster lease has distinct advantages over the 250-foot distance in that it is much easier to avoid mistakes in lease locations or in accidentally placing shot points on leases. Experimental studies of immediate blast effects on oysters tend to indicate that the distance may be safely placed as low as 250 feet, but this does not allow for human error in locating leases and shot points.

Some controlled research has been carried out on immediate blast effects on oyster mortality, latent effects, and the possibility of oysters sinking into mud from blast effects. The results to date are not conclusive and more tests should be made. This work, however, can be carried out regardless of existing rules. Results to date tend to indicate the following:

Immediate blast effect extends out from shot point not more than 100 feet and ofttimes less. Latent effects beyond this point are negligible if the bottom is hard and not disturbed by blasting. In soft bottoms we have some evidence that oysters may sink into the mud as a result of blasting.

It is concluded that seismic operations have been more easily enforced and complaints have been nil under the tem-



Some oysters are handled as many as 15 times before they reach the consumer's table. These oysters will be broken away from the clusters and put back onto the bed to continue growing.

porary set of rules in force during the past eighteen months. In our opinion the 30-day delay which allows time to prepare maps, make preliminary biological studies and notify all interested parties should be kept as a permanent regulation. Maintaining a 500-foot minimum working distance from oyster lease to seismic operation is a good rule because it allows space for human error in placing shot lines and locating leases. Proposed shot lines laid out at least 500 feet from all beds have done much to reduce conflict and complaints. When human error can be eliminated and accurate lease and shotpoint locations can be established, 250 to 300 feet will become a satisfactory distance.

The Commission unanimously agreed that the special rules and regulations pertaining to seismic operations expiring March 31, 1957 be continued in full force and effect until further notice.

In accordance with an agreement entered into many years ago between the oil companies and the Louisiana Wild Life and Fisheries Commission a Seismic Agent accompanies all seismic crews operating in Louisiana. These agents are all under State Civil Service, and are under the supervision of this Division.

A set fee of $480.00 is paid by the oil companies to our Commission for each crew operating in the State as well as in offshore waters. Agents' salaries, expenses, annual and sick leave, retirement, insurance, etc. are covered by this fee. We have received fine cooperation from almost all of the geophysical crews operating under our supervision and very few complaints are now reaching our office from these extensive operations.

It will be noted from the aforegoing table that there has been some reduction in seismic activity during 1957 as there were 204 less crews operating in 1957 than in 1956.

NUMBER OF SEISMIC CREWS OPERATING IN LOUISIANA DURING THE LAST TWO YEARS

	1956	1957
January	162	136
February	165	135
March	131	140
April	163	145
May	168	137
June	162	140
July	149	136
August	152	134
September	139	134
October	151	133
November	142	123
December	125	112
	1,809	1,605

Port of Entry

The Port of Entry formerly located at Grand Pass but totally destroyed by the storm of 1947 was rebuilt in Bayou Pierre, a much better harbor, located in St. Bernard Parish about one-half mile to the east of Grand Pass.

A Commercial Seafood Inspector remains at the Port of Entry at all times to check all out-of-state boats removing oysters and shrimp from Louisiana waters. A record is kept of the amount removed, and this record must check with the record of our agent at Biloxi, Mississippi, who collects all taxes assessed against canning plants which obtain oysters and shrimp from Louisiana waters.

A radio tower has been erected at the Port of Entry and this installation enables us to keep in close contact with all operations since we now have mobile units installed in all State-owned cars and airplanes.

Bay Gardene Seed Oyster Reservation

Bay Gardene was opened for dredging November 15th to November 30th of 1956, and 4,476 barrels of oysters were removed.

Bay Gardene was again opened for dredging November 1st, 1957 for a fifteen-day period, and 11,259 barrels of oysters were removed.

A Commercial Seafood Inspector is on duty at all times at the Bay Gardene Camp and continually patrols the area to see that no dredging is done in this reservation during closed periods.

On its way back from the oyster beds is this lugger loaded to the gunnels with succulent oysters that have made Louisiana's bedding grounds famous the world over.

BIOLOGICAL SECTION

OYSTERS, WATER BOTTOMS AND SEAFOOD DIVISION

LYLE S. ST. AMANT
Chief Biologist

A. V. Friedricks
Assistant Chief Biologist

Emery Hajdu
Biologist

The principal function of the biological section is to investigate oyster conditions, and prepare technical information regarding such conditions for the use of the Louisiana Wild Life and Fisheries Commission and its Oyster Division. Part of this work involves long range investigations aimed at bettering oyster production and quality and alleviating various ills of the industry. Of equal importance are short range studies designed to furnish the Oyster Division and Commission with the technical information upon which they can base rules and regulations and to aid them in making decisions concerning shell plantings, pipeline routes in oyster areas, and oyster-mineral industry relations. A third type of service provided by the biological section is direct technical aid to the individual oyster grower. In this case work is done on private oyster leases after an official request is made to the Oyster Division by the oyster grower. The following report summarizes, in part, representative types of work carried out by the biological section, details various other activities, and proposes a future program of work.

Oyster conditions in Louisiana waters have been gradually deteriorating since 1942 and 43. At first glance, this fact may not be apparent. True, the total oyster production for the State has fluctuated between 600,000 and 800,000 bbls. annually over the years, with few exceptions and this would tend to indicate that production in recent years is not seriously below normal (see statistical section). On the other hand, if one compares the yield per acre and the number of acres under lease, it is clearly seen that the production is down about 68% since 1943. (See table I).

TABLE I.
Oyster Production Changes From a Typical Area*

Year	Total Barrels	Barrels Per Acre	Bushels Per Acre
1942-43	246,066	56.4	169**
1955-56	219,823	18.7	56.4**

* These figures represent one parish where complete statistical data were available.

** The average per acre production shown here is considerably lower than can be expected on individual leases since all idle and unplanted leases were included in the total acreage used in determining the above figures.

Not only is the production per acre down but the quality of oysters has become poorer while the cost of production has obviously increased three or more times. The decline in oyster quality is due, to a large extent, to the fact that in most areas oysters cannot be grown through the second summer of their life without heavy mortalities. This has necessitated a change in the method of growing oysters so that 18 month old oysters make up the bulk of production. Such young oysters are smaller and more suitable for canning, the result being an increase in canned oyster production and a loss of high quality, better priced, raw shop and counter oysters.

LYLE S. ST. AMANT

The causes of declining oyster production in Louisiana are varied and complex. Basically ecological changes in oyster areas have been adverse. The waters have become more saline resulting in epidemic summer mortalities and heavy losses from predators such as the oyster drill. Seed oyster production is also down because of high saline conditions and possible excessive dredging neeeded to maintain production. Superimposed on these basic problems are numerous man-made problems involving losses from dredging in or near oyster beds, silting, pollution and the actual physical loss of productive oyster areas to industrial establishments.

Hydrographic Considerations

The exact causes of increased salinities along the Louisiana Coast cannot be documented because there is no volume of reliable hydrographic data available over the past 50 years. It appears that salinities have increased because of a complex interrelationship of factors involving flood control measures, drought conditions and an ever-increasing system of canal and channel dredging which is rapidly changing the topography of our coastal marshes. Basically most of the Louisiana marshes and inshore waters developed around the present and recent deltas of the Mississippi River and its distributaries. Before early flood control measures much of the marsh and littoral areas were flushed out and recharged with nutrient minerals annually by over flow river waters. As levees were extended down river and distributaries were cut off, recharging with fresh water became less frequent and oyster areas became dependent on extremely high river stages and heavy rainfall years for adequate fresh water. Drought and low river stages plus a diversion of a large portion of the Mississippi flow down the Atchafalaya in the past ten years has aggravated the situation and further increased salinities.

Superimposed on an already rapidly changing ecology and hydrography has been the recent great industrial expansion along our coast with its attendant extensive canaling and dredging. For any fresh water entering our marsh area to be of benefit, it must have time to mix with sea water in order to create the moderately saline brackish condition which has been the very basis of marsh and bay ecology and hydrography as it developed in nature. Meandering bayous and distributaries entering a system of bays in the lower marsh which feed into the gulf through narrow restricted passes, furnishes an ideal slow moving water system with the bays acting as large mixing bowls for salt and fresh water. Such a system of water flow created the high production of seafood,

To prevent silting, spoil material should be deposited in confined areas on shore. The above sea of mud, properly handled in this case, might have covered valuable oyster beds if pumped into the water.

An aerial photograph indicating how improper spoil deposition can interrupt normal channel and water flow.

Silt deposition resulting from dredging frequently kills oysters. This photograph shows oysters dead from silt (left) and normal oysters. (right).

Improper desposition of spoil material. Note the bay completely dammed off by the levees.

This dredge full of grass and mud represents material covering an oyster bed. The grass and mud in this case, washed from a rotting marsh through a newly dredged canal into an oyster area.

waterfowl and fur unique to the Louisiana marshes. In recent times an increasing number of canals and deep water channels with their spoil levees have been cut across the marsh both laterally and vertically. This has resulted in changed directions of water flow, the damming of flow by levees and has greatly increased the velocity of salt water flow into the marsh and fresh water flow through the marshes to the sea. The net result has been drastic increases in salinity in some areas and a rapid deterioration of productive marsh and bay conditions. (See photographs page 72-73).

Oil pollution is common where drilling operations are carelessly handled or when stream control regulations are broken. Note the extensive oil slicks in this area as well as spoil material in the center of the lake. Such conditions are illegal and can be quite detrimental to the production of oysters and seafood.

A suction dredge operating in an open bay. This type of activity can result in the silting of oyster reefs for considerable distances.

Proper dredging procedure can prevent damage to the natural ecology of the area. Note dams in dredged canal preventing the divergence of normal currents in a lateral direction.

Methods of alleviating the above conditions are not simple but two steps are vital if any success is to be assured. (1) Future canaling and dredging must be designed to have the least effect on existing natural conditions. This necessitates a careful hydrographic survey and analysis before dredging

This air photograph shows a suction dredge in operation. Note movement of silt through cut in improperly placed spoil bank and deposit of silt.

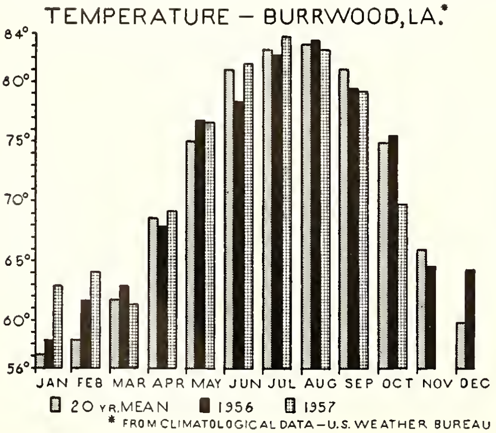
Air photograph showing various probelms created by industrial expansion in coastal areas. Not the following: (1.) Evidence of spoil in center of lake. (2.) Washing of spoil in low center of photograph and (3.) The general pattern of oil slicks and silt movements in the area.

This is one type of hurricane damage to oysters. Extreme tides wash dead marsh grass into the bays and cover oyster reefs. Oysters in this dredge are totally covered by grass.

permits are approved. (2) Fresh water from the Mississippi River will have to be reintroduced into the marshes through controlled outlets. At present one such outlet has been completed at Bayou LaMoque and three others are being considered by the Louisiana Department of Public Works and the U. S. Engineers upon recommendations by the Louisiana Wild Life and Fisheries Commission (See River Basin Section).

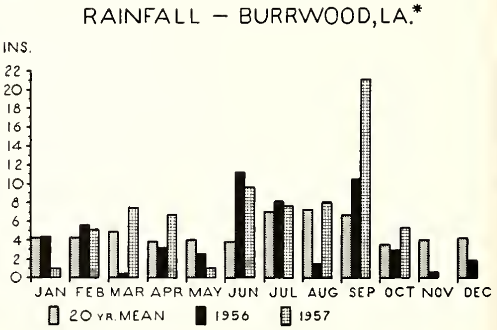
Weather

The effect of weather on oyster production is not dramatic or easily evaluated except in cases of catastrophies such as hurricanes or extreme droughts. Temperature effects can be both beneficial and harmful. For example, our generally mild winters and warmer conditions create a more rapidly growing oyster and enable oysters to reproduce nearly every month during the year. On the other hand, mild warm winters result in greater predator activity over longer periods and long hot summers increase mortalities from disease. Whether short term temperature changes noticeably effect oyster production is not easily determined accurately. In 1956 and 57 the winters were unusually mild (See Temp. graph) while in 1958 much colder weather prevailed. It is believed that this latter condition will aid production in 1958 and will reduce losses to oyster drills if the spring months are cold. The effects of rainfall are more obvious. Heavy nationwide rainfall with resultant high river stages lowers salinities and aids oyster production. Extreme drought and low rivers are detrimental to oyster production. Heavy rainfall in local marsh areas is probably helpful but not nearly so much as high river stages. In 1957, rainfall was above normal (See rainfall graph) and this coupled with high river stages materially reduced oyster drill activity and delayed or prevented drill reproduction. Summer mortalities did not seem particularly affected by this change.



* FROM CLIMATOLOGICAL DATA—U.S. WEATHER BUREAU

During the biennium Louisiana's oyster producing area has felt the force of several violent hurricanes. Oyster beds were examined after each one to determine if damage had occurred. The result of such studies indicate that widespread damage did not occur. In local areas wave action silted up some beds and actually piled up oysters or washed them away from beds. Of more widespread occurrence was the effect of extreme tides which flood the marshes and upon receding floated great amounts of dead marsh grass into the various bays where it sank and covered oyster beds. (See Photograph page 74). Fortunately no serious mortalities resulted from this condition.



* FROM CLIMATOLOGICAL DATA — U.S. WEATHER BUREAU

Problems of Oyster Industry Resulting From Industrial Advancement in the Coastal Area

Louisiana's rapidly expanding coastal mineral industry and the attendant canaling and dredging raises a series of problems peculiar to the Louisiana coast. The seriousness and extent of these problems may be realized by the fact that the Oyster Division, Louisiana Wild Life and Fisheries Commission averages approximately one complaint per week involving alleged damages from industrial operations. The problems referred to here should not be confused with the long standing question of whether oil or bleed water causes oyster mortalities but rather to a series of readily detectable damages which may be listed as follows:

1. Direct destruction of oyster beds by dredging, boat operation, and silting.
2. Indirect silting caused by improper handling of spoils, reduction of current velocities, and changes in the direction of current flow.
3. Oily taste in oysters resulting from improper disposition of oil emulsion or based muds and oil spillage.
4. Possible effects of seismic operations in areas wit certain ecological characteristics.

In making his examinations the biologist usually has littl trouble detecting and analyzing damages to oyster beds resulting from the direct effects of industrial operations. In mos cases, excessive silting is readily determined, or a dredge channel with adjacent spoil is easily found. (See photograp 2-11) Damages from grounded barges and propeller wash takes the form of intermittent holes in the bed and ridges of mud. The extent of damages is determined by surveying the area, making soundings and establishing the approximate amount of mortality from a random count of oysters and boxes. In all cases 20 to 25 oysters are examined for *Dermocystidium marinum* using Ray's (1952) thioglycollate method in order to rule out this disease as a probable cause of mortality.

In the case of indirect damages where usually silting and/or mortality occurs at some distance from the industrial operation, the problem is more difficult. The general type and extent of damage is determined by the same method described above. The exact mechanics of the changes usually falls into two types, namely, (1) reduction or complete cessation of current volocity by the damming of bayous or the total isolation of bays and inlets by spoil banks. This results in deposition of the normally suspended silt to the extent that in extreme cases navigation is disrupted. (2) In other cases, currents are diverted down new channels to the extent that the ecological characteristics of an oyster bed may change.

Gathering data to substantiate such changes is a difficult and usually a fruitless task since frequently conditions prior to the change are not known. In cases where a good prior knowledge of the area is had and where the changes are obvious, the mechanics of the change become apparent to the investigator. Though these instances are few, the ecological changes are generally so marked that it leads one to believe that this type of damage is much more widespread than might be expected. (See photograph 2-11)

Biological Services to Individual Oyster Growers

Because of industrial expansion, mineral exploration and production, and summer mortalities in oysters, the problems of the individual oyster grower have multiplied during recent years. When abnormal changes or losses occur on private oyster leases it behooves the owner to find an answer to his immediate problem. In order to aid the oyster grower with such problems the Biological section of the Oyster and Water Bottoms and Seafood Division offers a free extension type service that may be requested as follows. The oyster grower files an official request with the Oyster and Water Bottoms and Seafood Division after which the Biological section makes a field investigation of the problem, completes the necessary laboratory and chemical studies and furnishes the oyster grower with a report.

The need for such a service to the oyster grower is obvious and its popularity is apparent when it is realized that 36% of the work load of the biological section is spent in this direction. The type of damage or changes occurring are varied but most of them deal with direct or indirect effects of industrial expansion in the coastal area upon oyster culture. Table II lists the various types of complaints and the per cent of each from sixty investigations during the biennium.

TABLE II — TYPES OF COMPLAINTS

Cause of Damage	No. of Cases	Per Cent
Seismic Operations	8	13.3
Silting and Dredging	25	41.6
Oily Taste in Oysters	9	15.0
Ecological Changes	4	6.6
Examination prior to dredging	5	8.3
Marsh Buggy damage to the lease	3	4.0
Oyster Diseases	1	1.7
Unknown Causes	5	8.3
Total	60	99.8+

It is evident from the above data that the bulk (65%) of all work is directed at the effects of dredging, silting and oil drilling and production operations on oysters, which is indicative of the rapid expansion of this industrial complex in coastal waters. Table III lists the various complaints by location, types and results of the study.

The value of this type of biological investigation to the individual oyster grower is obvious, but such short term studies do not lend themselves to determining basic biological facts which can be used for bettering the oyster industry as a whole. Only undisturbed long range investigations can hope to achieve such ends. The effectiveness of such investigations and reports to the individual oyster grower can be greatly enhanced, however, if he or the industry involved will take the following steps:

1. Request a preliminary examination of the area just prior to the start of industrial activity and a second examination after the work is completed.
2. If preliminary examinations are not possible request an examination as soon as damage is apparent. Examinations several months after the initial damage are usually valueless.
3. Arrange to have both parties concerned present at the time of the field examination.

Investigations of Oily Taste in Oysters Caused by Oil Drilling Operations

At the time of the initiation of the present biological research program in 1955, oily taste in oysters was a problem of some consequence involving nearly 40% of the complaints received from oystermen. Based on the results of the investigations reported below, the Stream Control Commission has invoked stricter regulations which have decreased pollution of this type to the extent that only 15% of the complaints now involve oily taste. It is hoped that increased enforcement will futher reduce this precentage in the future.

In some of our early investigations on oil taste in oysters it was noted that extreme cases of contamination occurred in areas where drilling rigs were in apparent compliance with coastal waste control regulations and which had been regularly inspected by competent inspectors. Oil line breakage had not occurred nor were oil slicks evident. Organoleptic tests indicated strong diesel or kerosene like taste in the oysters which became even more obvious after. steaming. Canned oysters and raw stock from such contaminated areas were condemned by the State Board of Health.

In attempting to discover the source and cause of contamination we analyzed mud and water samples chemically for ether soluble materials. Unusually high ether soluble fractions were discovered in the mud samples at times ranging as high as 14,000 ppm (1.4%) and such samples had a strong, distinct oily odor. In most cases a descending progression of contamination occurred from the oil well site toward the contaminated beds but in a few instances the area of highest contamination was at a distance of 500 or more feet from the well site. Analysis of water samples indicated some contamination but rarely did it exceed 100 ppm and in most cases fell within acceptable limits of 30 ppm.

It was noted that many of the mud samples were reddish in color, characteristic of baroid drilling muds which led to a discussion of the use of the mud with drilling rig operators and petroleum engineers at Louisiana State University. In brief it was learned that mud is normally pumped into the well mixed only with water but in wells drilled deeper than 10,000 feet in Louisiana it is a common practice to mix as much as 14% diesel oil by volume with the mud to lubricate the drill stem. It was this type oil emulsion mud and cuttings from the well contaminated by the presence of oil which proved to be the principal source of oil contamination in oysters. Unfortunately, for the oyster

Table III. Complaints by Areas and Types

Project Number	Area, Parish	Nature of Complaint	Conclusions of Biological Section
1	Bayou Dantin, Terrebonne Parish	Oysters had developed an oily taste	Oily taste in oysters due to pollution
2	Point Au Fer, St. Mary Parish	Dredging on Lease	Shell dredge went through part of lease
3	Bay Long, Plaquemines Parish	Oysters had developed an oily taste	Oily taste in oysters due to pollution
4	Bayou Fer Blanc, Jefferson Parish	Seismic Operations on Lease	Marsh buggies caused 40% mortality by crossing lease during low tide
5	Bay Hollandra, Lafourche Parish	Silting	Mortality due to silting from dredging operation
6	Bay Lanaux, Plaquemines Parish	Oily taste in oysters	Oily taste and mortality due to pollution
7	Bay Lanaux, Plaquemines Parish	Oily taste in oysters	Oily taste and mortality due to pollution
8	Bayou LaChute, Plaquemines Parish	Silting	No cause for complaint discovered
9	Bayou Pierre Lee, Lafourche Parish	Silting	Silting destroyed lease
10	Grand Bayou Blue, Lafourche Parish	Silting	Mortalities probably due to silting
11	Sand Point Bay, Plaquemines Parish	Silting	Mortalities due to silting from dredging operation
12	Manilla Bayou, Jefferson Parish	Silting	80% mortality due to silting from dredging operation
13	Grand Bayou, Plaquemines Parish	Silting	
14	American Bay, Plaquemines Parish	Silting	Destruction of bedding grounds due to dredging operations
15	Shell Island Bay, Plaquemines Parish	Silting	Mortalities due to silting from dredging operation
16	Grand Bayou, Plaquemines Parish	Silting	Mortalities due to silting from dredging operations
17	Bayou des Huitres, Plaquemines Parish	Silting	Mortalities of unknown etiology
18	Grand Bayou, Plaquemines Parish	Silting	Destruction of part of lease by dredging
19	Bay Tambour, Plaquemines Parish	Silting	Dredging operation caused some mortalities to oysters
20	Bay Scofield, Plaquemines Parish	Seismic Operations	Mortality due to the oyster fungus, *Dermocystidium marium*
21	Redfish Bayou, Terrebonne Parish	Silting	Caused silting of lease, mortality of unknown etiology
22	Grand Bayou, Plaquemines Parish	Silting	Tug went aground, made channel thru lease
23	Sandy Point Bay, Plaquemines Parish	Silting	Mortality due to silting from dredging operation
24	Lake Grande Ecaille, Plaquemines Parish	Silting	Silting found on part of lease
25	Bay Gaspar,		
26	Grand Bayou, Plaquemines Parish	Silting	Tugboat went aground, made channel thru lease
27	Bay Chinois, Lafourche Parish	Seismic Operations	Marsh buggy tracks across lease, with no appreciable damage to lease
28	Bayou Cook, Plaquemines Parish	Dredging and silting	Mortality, probably due to silting dredging operation
29	Bay Coquille, Plaquemines Parish	Oily taste to oysters	Pollution in area caused oily taste in oysters
30	Bayou LaChute, Plaquemines Parish	Oily taste	Pollution in area caused oily taste in oysters
31	English Bayou, Plaquemines Parish	Oily taste	Pollution in area caused oily taste in oysters
32	Bay L'eau Duece, Lafourche Parish	Examination prior to dredging requested by Oysterman	Not called back on this matter
33	Mudhole Bay, Terrebonne Parish	Silting	Oyster production no longer profitable due to constant dredging operations
34	Bayou LaChute, Plaquemines Parish	Silting	Silting and oil pollution resulting from dredging operations
35	Bay des Ilettes, Jefferson Parish	Oily taste in oysters	Oily taste in oysters due to pollution
36	Cat Bay, Jefferson Parish	Seismic operations	Mortality of oysters of unknown etiology
37	Sandy Point Bay, Plaquemines Parish	Ecological change in area	Dredging of canal allowed influx of fresh-water into area causing oyster mortality
38	Bay Tambour, Plaquemines Parish	Ecological change in area	Dredging of canal allowed influx of fresh-water into area causing oyster mortality
39	Bay Tambour, Plaquemines Parish	Ecological change in area	Dredging of canal allowed influx of fresh-water into area causing oyster mortality
40	Pelican Lake, Terrebonne Parish	Examination of area prior to dredging operations	Suggestions made to dredge operator, and notes on condition of lease made
41	Grand Bayou, Plaquemines Parish	Silting	Dredged canal thru lease, destroying it
42	Sandy Point Bay, Plaquemines Parish	Silting	Silting probably occurred 17 months ago, but too late to determine the extent of damage
43	Sandy Point Bay, Plaquemines Parish	Silting	Silting probably occurred 17 months ago, but too late to determine the extent of damage
44	Grand Bayou, Plaquemines Parish	Silting	No damage could be seen on this lease.
45	Baptiste Collette, Plaquemines Parish	Ecological change in area	Freshwater from canal, blocks were added to alleviate trouble
46	Bayou Cook, Plaquemines Parish	Silting	75% of lease silted from dredging operations
47	Bayou Coteau, Terrebonne Parish	Silting and oil pollution	63% mortality of unknown etiology
48	Bayou St. Denis, Jefferson Parish	Seismic operations	Illegal Shot Point on lease
49	Second Bay, Plaquemines Parish	Silting and dredging	Examination of lease prior to dredging operation
50	Bayou Roseaux, Lafourche Parish	seismic operations	Marsh buggy tracks across lease; causing limited damage
51	Bayou Chicharas, Plaquemines Parish	seismic operations	Marsh buggies crossing lease caused mortalities to oysters
52	Bay Couteau, Terrebone Parish	Silting and dredging	Change in ecology destroyed area for oyster production
53	St. Mary's Pt., Barataria Bay, Jefferson Parish	Silting and oil pollution	Oil pollution has made the area unfit for oyster production
54	Saturday Island, Barataria Bay, Jefferson Parish	Silting and pollution	Oil pollution has made the area unfit for oyster production
55	Timbalier Bay, Lafourche Parish	Seismic operations	Shot Points on lease
56	Grand Pass Felicity, Lafourche Parish	Seismic operations	Marsh buggies crossed lease, causing mortality
57	Bay Courant, Lafourche Parish	Seismic operations	Shot points on lease
58	Scofield Bay, Plaquemines Parish	Seismic operations	Shot points on lease
59	Bay Junop, Lafourche Parish	Dredging operation	Examination prior to dredging operation
60	Bay Welch, Terrebonne Parish	Dredging operation	Examination prior to dredging operation

grower in Louisiana most of the wells in the coastal area of Louisiana usually exceed 10,000 feet in depth.

Since our initial investigations, we have studied numerous complaints of this type and have collected a considerable amount of field and chemical data. Publication of the details of the investigations awaits the completion of controlled laboratory experiments but certain generalizations may be made at this time which should aid other investigators faced with the problem. These are as follows:

1. The distance which contamination can occur from the well varies with many factors but it can affect oysters as much as 2500 feet in open bays and 5000 or more feet in closed channels or bayous.
2. Dissipation of the oil taste varies with the amount of contaminating mud present and the characteristics of the area. In open bays a reduction in noticeable oil taste may occur in 40 to 60 days and be undetectable after four to six months. In narrow bayous and isolated bays not subject to tidal flushing, contamination was observed to last more than one year.
3. Boat traffic in shallow contaminated bayous and bays aggravates the contamination.
4. In all cases of distinct contamination, ether soluble fractions in mud samples ranged from twice to as much as 100 times as high as controls from the area.
5. The more volatile oils (diesel or fuel oil) are most effective in contamination. Heavier tar based oils may impart little or no taste to oysters under field conditions.
6. Volatile oils emulsified with mud or adsorbed on well cuttings are much more efficient and longer lasting as a contaminant. Spillage and line breaks resulting in surface slicks allow the volatile fractions to be evaporated and apparently cause contamination only after heavy losses along wave washed shorelines or in turbid waters which allow the oil to be adsorbed on silt particles and sink.

Laboratory Experiments in Progress

Preliminary controlled laboratory experiments involving oily taste in oysters caused by oil in drilling mud have been completed and a series of new experiments are being prepared. In the initial experiments the following procedure was used. Four experimental tanks were set up as follows—

Tank #1. (Experimental) The bottom of a 30 gallon tank was covered to a depth of 1.5 inches with mixture of typical bottom mud and oil emulsion based mud in such a ratio as to provide an oil content upon analysis of approximately 11,000 p.p.m.. Sea water was added to the tank and the bottom was allowed to stabilize for one week. After stabilization a continuous flow of sea water was fed into the tank at the rate of 180 c.c. per minute.

Tank #2. (Experimental) Contained a substrate of 1 inch of dry shale cuttings taken from the mud washing system of a drilling rig and covered with sea water for one week to stabilize. After stabilization, sea water was run into this tank at the rate of 180 c.c. per minute.

Tank #3. (Control) Contained a substrate of 1.5 inches of bottom mud from Barataria Bay. It was stabilized for one week in sea water before running water was fed into the tank at 180 c.c. per minute.

Tank #4. (Control) This tank was a standard aquarium without substrate. Sea water was run into the tank at 180 c.c. per minute.

After the various tanks were prepared and stabilized 16 oysters were placed in each tank. An additional 16 oysters taken from the same source were tasted by four different individuals as a taste control. All were in prime condition and showed no evidence of oil. After one week of exposure all oysters were removed from the tank and numbered. Four oysters from each tank were mixed in test groups of 16 and were tasted by individuals who had no knowledge of which oysters came from which tank. In this manner objective and unbiased opinions were rendered. In all tests all oysters from tank #1 containing 11,000 p.p.m. of oil were strongly oily and unpalatable. Some individuals noted an oily taste in oysters from tank #2 with shale cuttings but others found no taste. The amount of oil adhering to the shale could not be measured. Since the shale cuttings had been washed and no oil odor was noted, it is assumed that the oil content was low. All taste tests from the two control tanks proved to be negative for oil taste.

The above experiment was repeated shortening the time of exposure until 48 hours. In this case the same results were obtained. Experiments were repeated for a period of 10 months through a summer and winter period. The same substrate was used without changing or recharging with oil. After 10 months an oyster still picked up an oily taste in about the same time (48 hours) and to the same degree of unpalatability.

It is evident from these experiments that oil does not readily wash out of mud and in high concentrations is easily picked up by oysters. More experiments using various amounts of oil are being carried out. Attempts will be made to wash the oil from contaminated oysters by transferring them to another tank.

Growth and Mortality Rates of Louisiana Oysters

The size and density of an animal population is controlled by the reproductive, growth and death rates which in turn are affected to a considerable extent by the environment. If the reproductive rate is reasonably constant and the environment suitable then the size of a population is regulated by the growth rate and death rate. If growth is rapid and the mortality rate reaches a peak only in very old individuals, the population will be large and a large portion of the individuals will be adult. On the other hand, if the mortality rate reaches a peak in young individuals and growth is slow the population will be smaller and there will be fewer old well developed individuals.

Oyster production in Louisiana has declined on a per acre basis since 1943. The principal reason for the decline is apparently due to a greatly increased mortality (death rate) which occurs during the second summer of the oyster's life. Such an early death before most oysters have reached two years of age has both reduced oyster production and virtually eliminated the large two, three and four year old oysters which once made up the choice counter and raw stock oysters of Louisiana. It is obvious that if Louisiana's oyster production is to be restored to its former excellence, a way must be found to prevent heavy mortalities during the second summer or a more rapidly growing variety of oyster will have to be developed. Some increase in the production and quality of oysters may be had by careful selection of fall and winter set oyster spat, growing them through only one summer and harvesting them the following spring. Such a course of action necessitates a good source of fall spat and protection from oyster drills during the first 10 months of life.

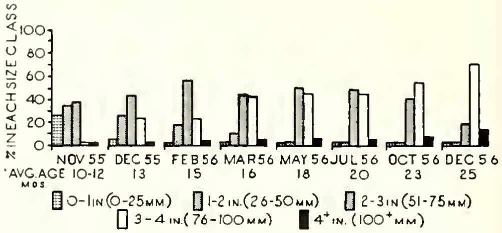
During the past three years the biological section has investigated the growth and death rate of Louisiana oysters on experimental beds and in cages where the individual oysters could be identified. The purpose of these experiments is to develop a series of data from which mortality and growth rates can be predicted. With such information available the Oyster Division can better advise oyster growers when to plant oysters, the age of seed to use, and what types of environmental conditions give the most rapid growth. Such data will also be useful in future experiments aimed at controlling mortality rates and developing a more rapidly growing variety of oyster.

Growth Investigations

Oysters grow at different rates in summer and winter and in waters of low and high salinity. Most rapid growth usually takes place in waters of relatively high salinity during the winter and spring months. It is for this reason that seed oysters are collected, transported and replanted in the lower salty bays along the Louisiana Coast. In such areas they rapidly attain a large size and a high quality of meat.

In one set of growth experiments seed oysters were planted in November 1955 on an experimental bed in a typical high saline area. The growth and mortality of these oysters were checked frequently over a period of one year. In collecting data random samples were taken from the bed, all oysters were measured and the data recorded in five size groups, i.e. 0-1 inch, 1-2 inches, 2-3 inches, 3-4 inches and 4+ inches. In this manner, samplings of young oysters will show a high percentage of all oysters to fall in the small classes below three inches. As growth proceeds greater and greater percentages will appear in the larger class groups. Table IV shows a summary of all data from random samples from the experimental bed. It is evident from these data that growth was rapid until April 1956. After April and throughout the summer the growth picture is complicated by rapidly increasing mortalities and the appearance of new set oysters. From October into the winter further growth is evident when only live oyster data is considered. These same data are also presented in Graph I which shows more clearly the increase of oysters in the larger size groups as growth occurs.

GRAPH I - GENERAL GROWTH RATE CHARACTERISTICS OF NORMALLY* BEDDED OYSTERS



* NOTE - THESE GRAPHS ARE CONSTRUCTED FROM COUNTS OF RANDOM SAMPLES AND ARE INFLUENCED TO SOME EXTENT BY MORTALITIES AND NEW SPAT FALL

Attempting to determine accurate growth rates from random samples taken from normally bedded oysters leaves much to be desired. True, the results obtained demonstrate the condition of normally bedded oysters at the time sampled, but newly set spat and mortalities tend to give a false impression of what has actually happened to the oysters originally bedded. A more accurate picture of growth is obtained when oysters are grown in cages and are studied individually.

Growth in Caged Oysters

In another group of experiments some 600 oysters were tagged and their growth and mortality was investigated individually. These oysters were selected as very small spat shortly after setting, held until large enough to tag and identify, and then grown in cages for a period of 12 to 21 months. Two general groups were studied; (1) oysters set in April and May, and (2) oysters set in November, December and January. The growth picture was less complicated in these investigations because mortalities from predators was eliminated, new sets of oysters were eliminated, and the growth of individual oysters was observed. Graph II and Table V demonstrate clearly the rate of growth in these caged oyster experiments. It is evident from these data that

TABLE IV

Growth and Mortality of Oysters From Experimental Beds Expressed in Percentages

			Percent Live Oysters in Size Groups				
			0-1 In.	1-2 In.	2-3 In.	3-4 In.	Over 4 In.
Date	% Live	% Dead	0-25 mm.	26-50 mm.	51-75 mm.	76-100 mm.	Over 100 mm.
11- 4-55	97.60	2.40	10.82	38.03	39.72	11.42	0.00
12- 7-55	96.86	3.14	26.31	34.62	37.65	1.82	0.00
12-13-55	92.60	7.40	5.10	26.33	42.47	23.13	2.96
2- 8-56	94.85	5.15	0.36	17.20	56.70	21.40	3.00
3- 1-56	93.89	6.11	1.37	9.25	44.52	41.10	5.14
4- 6-56	86.40	13.60	-	12.6	40.1	40.1	7.01
			Total 2.74	13.40	46.04	35.73	2.06
5- 2-56*	71.47	28.53	Live 0.96	2.80	49.51	43.75	2.80
			Dead 7.22	39.77	37.47	15.66	0.00
			Total 2.44	11.88	44.40	31.81	3.49
5-17-56	70.63	29.37	Live 1.48	8.41	41.58	44.08	8.85
			Dead 4.76	40.47	51.19	2.38	1.19
6-21-56	57.92	42.08	Total 0.77	15.44	49.42	32.04	2.31
			Live 0.66	6.00	46.66	43.33	3.33
			Dead 0.91	28.44	53.21	16.51	0.91
			Total 1.23	8.45	51.34	34.84	4.33
7-10-56	64.56	35.44	Live 0.63	2.23	47.60	43.13	6.39
			Dead 2.32	19.76	51.34	19.76	0.57
			Total 13.4	11.1	47.9	24.5	2.7
7-25-56	50.00	50.00	Live 11.1	2.2	50.0	31.1	5.5
			Dead 15.7	20.2	46.1	17.9	0.0
9-13-56	39.8	60.2					
			Tota 0.0	2.9	55.4	38.7	2.9
10-16-56	20.7	79.2	Live 0.0	0.0	40.0	53.3	6.6
			Dead 0.0	3.7	59.81	34.5	1.8
			Total 0.0	1.7	47.4	47.0	3.8
12- 7-56	17.5	82.5	Live 0.0	0.0	17.1	70.7	12.2
			Dead 0.0	2.07	53.9	41.9	2.1

* After May, mortalities increased to the extent that it became necessary to list live and dead oysters separately in order to best show growth and mortality.

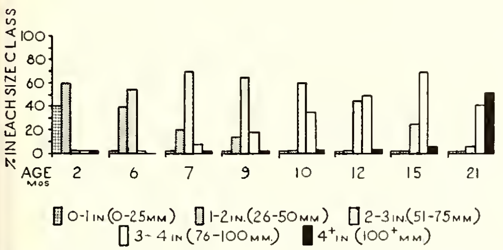
oysters grow very rapidly in Louisiana waters. After 12 months most of the oysters are larger than two and a half inches and are nearing market size, however, it is not until 15 to 21 months that three, four and five inch oysters make up the bulk of the population. Unfortunately growing oysters to 21 months of age requires that they be grown through a second summer when they suffer a high mortality.

TABLE V
Growth Rate of Tagged Oysters in Cages
Spring Spat — Set 4-12-56 - 5-12-56

Date	Age in Months	Percent Live Oysters in Size Groups				
		0-1 in.	1-2 in.	2-3 in.	3-4 in.	4+ in.
		0-25 mm.	26-50 mm.	51-75 mm.	76-100 mm.	101 mm. +
6-12-56	½-1	100%	—	—	—	—
7-12-56	2	40.0%	60.0%	—	—	—
11- 4-56	6	0.44%	41.40%	57.26%	1.30%	—
12-10-56	7	—	21.69%	70.75%	7.54%	—
1-30-57	9	—	14.60%	64.29%	19.63%	0.45%
3-14-57	10	—	2.21%	60.18%	34.95%	2.65%
5- 1-57	12	—	1.75%	46.19%	49.12%	2.34%
8-27-56	15	—	—	27.00%	68.25%	4.76%
2-20-58	21	—	—	6.06%	42.42%	51.51%

The growth rate of the individual oysters of the same age and held in the same environment is highly variable.

GRAPH II - GROWTH RATE CHARACTERISTICS OF TAGGED OYSTERS FROM SPAT TO ADULT



Such variations in growth rate are clearly seen in Photograph below. Shown are 16 oysters ranging from one and a half to five inches selected from a group of 250 eleven month olds that were grown in the same cage. Such a wide variation in growth tends to indicate that there may be a fast growing variety of oysters in Louisiana which may be isolated and cultured. It is also quite possible that a normal biological growth curve is in evidence here which could preclude a simple establishment of a rapid growing variety of oyster. Further evidence of variations in individual growth rates is depicted in Graphs III and IV. In this study of 36 individual oysters from April to July rapid growth is very evident and weight gained is marked.

This photograph demonstrates variations in the rate of growth of oysters. These oysters are all 11 months old and were grown in the same cage.

Growth investigations are being continued with special emphasis on which spat sets (i.e., spring, summer, fall and winter.) will give the maximum growth before heavy mortalities occur. Attempts are being made to isolate spat from rapidly growing oysters in order to determine if the offspring will show fast growing characteristics.

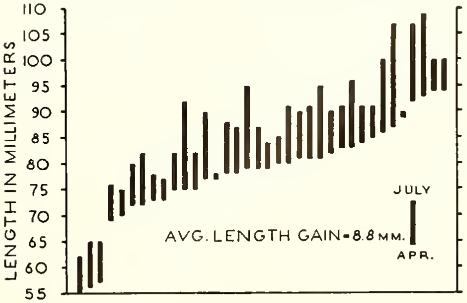
Mortality Investigations

When considering mortalities in oyster populations several facts should be kept in mind. First, a certain percent of deaths can be expected in any animal population that might be considered normal. In oyster populations some individuals can be expected to die of old age, starvation, predation, silting, overcrowding, disease and in the case of bedded oysters from dredging and handling. The exact percent of such "normal mortalities" is difficult to define and may vary from place to place or from season to season. Experience and the general concensus of most investigators and oyster men indicates that if the total mortality in a population of bedded oysters does not exceed 15% to 20% over the growing period, production is normal. Abnormal mortalities usually occur with rapidity and in most cases greatly exceed the 20% reference level.

Secondly, abnormal mortalities may be caused by a single or combination of factors acting together. In Louisiana, excepting mortalities caused by physical damage, such as silting, burying, excessive fresh water, gross pollution, etc., it is generally thought that abnormal mortalities result either from predation by the oyster drill or from one or more diseases. The so-called "summer mortalities" that have devastated the oyster industry since 1940 usually occur in the second summer of the oyster's life and are attributed to the effects of a fungus infection, *Dermocystidium marinum*.

Mortality investigations have been carried out in connection with all of the experiments involving growth. Mortalities in normally bedded oysters are listed in Table IV. In this study the oysters were bedded in November and the age of the seed used was from 8 to 12 months; all of which had lived through one summer season. It will be noted that mortalities on the bed did not exceed 20% until the following May, the start of the second summer of the oyster's life. Mortality then rose rapidly from 29% in Mid May to 79% in October. This is a typical example of summer mortality. The gradual rise in mortality from 5% in February to 28% in May

GRAPH III
VARIATION IN GROWTH RATE OF INDIVIDUAL OYSTERS BETWEEN APRIL AND JULY-1956



is an indication of predation by snails (oyster drills). During the summer and fall months rapidly increasing mortality is associated with the fungus disease, *D. marinum.*

Clearer evidence of the difference in the two types of mortality is seen in Graph V. Oyster drill predation starts as soon as the water warms up in the spring and is most severe in small oysters which can be easily drilled by the snail. In Graph V, it is seen that oysters under 50 mm. (2 inches) in length died early and were practically all destroyed by April and May. On the other hand, large oysters less subject to drill predation did not exceed 20% mortality until June and July after which losses rose rapidly to more than 60% as summer mortalities began to appear. Further evidence of the difference between snail losses and summer mortality is seen in Table VI, below.

GRAPH V- SHOWING MORTALITY RATES OF VARIOUS SIZE GROUPS OF OYSTERS

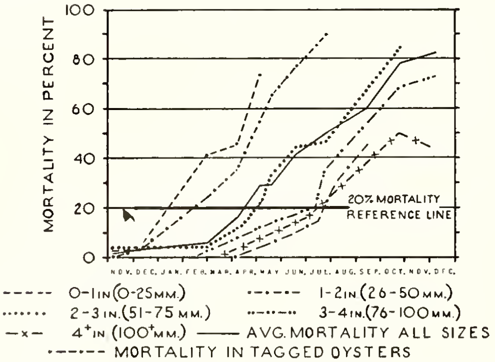


TABLE VI

A Comparison of Mortality Between Caged and Bedded Oysters During the Summer Months

Caged Oysters*		Bedded Oysters**	
Date	Per Cent Mortality	Date	Per Cent Mortality***
April	0.0	April	0.0
May	6.5	May	16.0
June	....	June	29.0
July	13.0	July	37.0
August	32.6	August	....
September	44.2	September	44.0

* Medium and large oysters selected from the experimental bed and caged to prevent drill predation.

** All sized oysters bedded-subject to drill predation.

*** Mortalities on beds corrected to account for mortalities prior to April.

It is evident from the data in Table VI that caged oysters protected from oyster drill predation did not show a serious mortality rate until August while in bedded oysters 29% mortality occurred as early as June. It is interesting to note, however, that the final mortality in both groups was the same by September. The mortality rate of caged oysters is also plotted in Graph V for comparative purposes (See Line 7).

As in the case of growth studies—mortality data from normally bedded oysters may become complex because of new rapidly growing spat, loss of shells which serve as evidence of mortality and the fact that seed oysters suitable for bedding experiments are already 8 to 12 months of age before data can be collected. To get a clearer picture of oyster mortality from set to adult, some 500 spat were selected and caged when quite young (one to two months old). The oysters were kept in cages and individually numbered as soon as they were of sufficient size to work with. Table VII summarizes the data showing the percent of mortality between each examination and from the beginning of the experiment in spring set spat. Graph VI summarizes the data in the form of a mortality curve. Table VIII presents similar data for two groups of fall and winter set spat.

TABLE VII

Mortality Rate of Spring Spat — Set April-May 1956

Date	Total Oysters	Live Oysters	Number Dead Since Last Check	% Dead Since Last Check	% Dead Since Start of Exp.	Avg. Age in months
7-12-56	244	244	0	0	0	2.5
11- 4-56	244	227	17	6.9	6.9	6
12-10-56	217	212	5	2.3	13.1	7
1-30-57	212	206	6	2.8	15.5	9
3-14-57	206	206	0	0.0	15.5	10
5- 1-57	206	197	9	4.3	19.0	12
6- 5-57	197	162	35	17.7	33.6	13
8-27-57	162	126	36	22.2	48.3	15
2-20-58	126	80	46	36.5	67.2	21

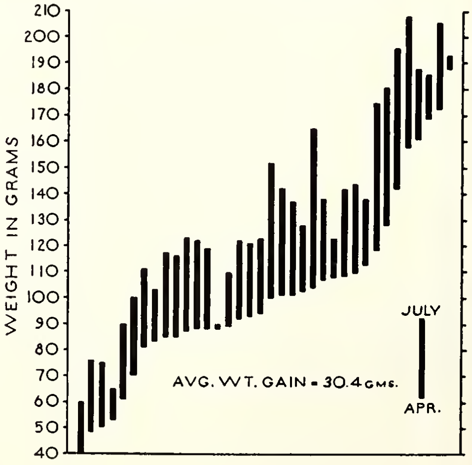
TABLE VIII

Mortality Rates in Two Sets of Fall and Winter Spat

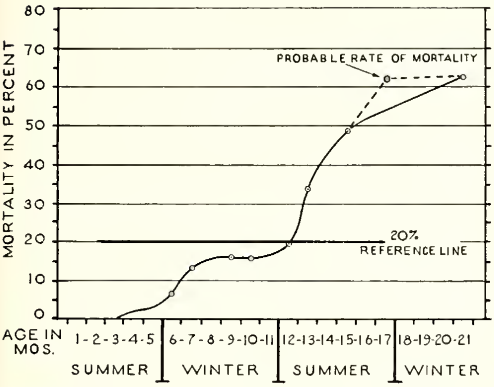
Date	Total Oysters	Live Oysters	Dead Oysters	% Dead Since Last Check	% Dead Since Start of Exp.	Avg. Age in months
3-14-57	255	255	0	0	0	2
5- 1-57	255	255	0	0	0	4
8-27-57	241	203	38	18.7	18.7	7
2-20-58	203	123	70	34.7	48.0	13
1-30-57	89	89	0	0	0	2
3-27-57	89	89	0	0	0	5
6- 5-57	89	81	8	9	9	8
8-27-57	81	56	25	30.8	32.7	10

It is clear from Table VII that oyster spat which set in March, April and May survive through the first summer with a very low mortality when protected from oyster drills and show little evidence of serious mortality until they are 12 months of age and enter the second summer of their life span. At this time many of the oysters are three and four inches long and suitable for market. (See Graph II). From this evidence it has been assumed that oysters set in the fall and winter would also survive the next summer with low mortalities and would result in more growth by harvesting time in the second spring since they would be from 14 to 18 months of age. In Table VIII the data is recorded from such an experiment. The results here, however, indicate rather high mortalities ranging up to 32% during the first summer and as high as 48% in one group after 12 months of growth. Such results are contrary to that expected and to what is

GRAPH IV
VARIATION IN WEIGHT GAIN OF INDIVIDUAL OYSTERS BETWEEN APRIL AND JULY-1956



GRAPH VI - MORTALITY RATE OF TAGGED CAGED OYSTERS FROM SPAT TO ADULTS



generally believed to be the case by many investigators. This experiment is now being repeated to determine if an error was made or if there is a fallacy in recommending fall and winter spat as a better type of seed oyster.

The data presented here represents preliminary investigations into the growth and mortality of oysters in Louisiana waters. Studies are being continued with particular emphasis being directed toward establishing mortality curves for oysters set in different seasons of the year and comparing such mortality rates with the incidence of *D. marinum*.

The Southern Oyster Drill

The southern oyster drill, *Thais,* is a carnivorous snail which feeds on oysters to the extent that in some areas they cause serious losses to the industry. There is little doubt that if this oyster pest could be controlled or eradicated it would be a boone to the oyster industry. Various investigators have made some mention of this animal since 1900. Burkenroad (1931) and St. Amant (1938) have presented the most comprehensive studies on the biology and embryology of *Thais* and in more recent years rather extensive work has been done on the growth rate and feeding habits by Butler (1953) at the U. S. Fish and Wildlife Service laboratory at Pensacola, Florida. At present, various types of investigations are being made at laboratories along the Gulf Coast. The morphology of the oyster drill is being studied in Mississippi, biological control methods are under investigation at Pensacola and the embryology, setting, feeding and possible control methods are being examined in Loiusiana.

The work being carried out by the biological section, Louisiana Wild Life and Fisheries Commission and which is being presented, in part, in this report has the following aims:

1. A general review of the biology and embryology of the drill consisting of a series of laboratory and field experiments designed to allow the writer (St. Amant) to further verify and extend his original studies made in 1936 and 1937.
2. Further and more complete observations of feeding habits, rates of feeding and the effects of feeding on oyster production.
3. Studies of the changes and growth in snail larvae from hatching to setting.
4. Investigations of the relationship of the setting time of snail and oyster larvae and the extent of predation by tiny new set snails on newly set oysters.
5. Examination of possible chemicals and electrical methods of controlling snails.

Description

The southern oyster drill is a snail averaging about two and one half inches in length with maximum sizes exceeding four inches. Actually there are two subspecies of this snail existing in Louisiana coastal waters; one, *Thais haemostoma floridana* is more common east of the Mississippi river, and the second *Thais floridana haysae* is more prevalent west of the Mississippi. The ranges of both overlap and according to Butler they can inter-breed successfully. Both snails are shown in Plate I.

Distribution, Density and Habits

Thais is found in most coastal waters having a salinity range from 15 to 35 parts per thousand and on all bottom types. They have been found as far as 15 miles off shore, but the heaviest concentrations are usually associated with natural oyster reefs or bedded oysters. In some of the more heavily infested areas the population density may reach several hundred thousand per acre and probably at times exceeds the total number of oysters in the same area.

The adult oyster drill, like most snails, moves slowly although it can reach speeds of 12 to 30 feet per hour. Migration across large expanses of non-oyster bottoms is possible and the fact that drills will rather rapidly locate oysters in a trap or cage placed well away from a reef or bed indicates that they do move considerable distances. Distribution of snails over wide areas probably results from the free swimming characteristics of the larvae for a short time after hatching. Since newly hatched snails are a part of the plankton they may be carried great distances by tidal and wind currents.

The general breeding and feeding activity of the oyster drill is controlled largely by temperature. Below 12° C (55° F) they become inactive, and may bury themselves in the mud.

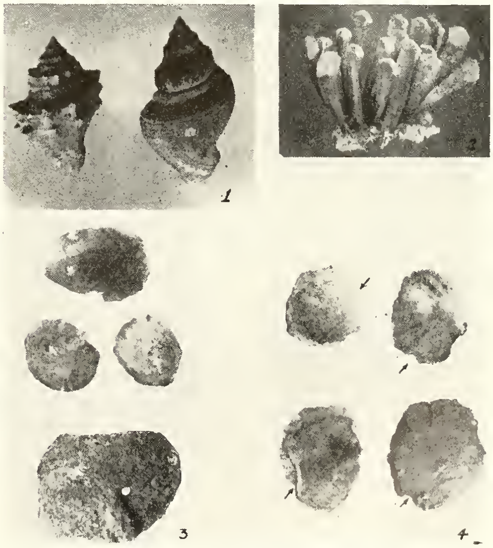


PLATE I. OYSTER DRILL

Figure 1.—The adult oyster drill, showing the two subspecies, 1 *Thais haemostoma* and r. *Thais haemostoma haysae.* (Clench) Reduced to one-half size.

Figure 2.—Egg capsule of the oyster drill. Each case contains 500 to 2000 eggs. x 300.

Figure 3.—Oyster spat shells showing Oyster drill (*Thais*) holes in the center near the vital parts.

Figure 4.—Oyster spat shells showing oyster drill (*Thais*) holes at the periphery. Note that holes (arrows) are barely visible.

Activity resumes as soon as the water warms slightly and snails have been observed actively feeding at 19° C. It is quite probably that during mild winters the drill remains active most of the time. Sudden drops in salinity below 14 parts per thousand will cause the adult snail to become inactive and will kill snail larvae. If salinites remain low for long periods of time during warm weather adult snails will be killed. Because of this fact, dense snail populations are not found in waters with a mean salinity below 14 parts per thousand and the introduction of fresh water into a high saline area can be used to control or eradicate this predator.

Feeding Habits and the Effects of Predation on the Oyster Industry

The mechanics of feeding in *Thais* is the same as other carnivorous snails. The feeding organ consists of an elastic, eversible tube called a proboscis. The snail can extend this flexible tube to a length at least equal to the length of its body and can manipulate it with considerable dexterity. At the tip of the tube is a mouth opening inside of which is a rasp-like band of teeth called a radula. By slightly everting the mouth and moving the band of teeth by a muscle lying in the floor of the cavity, a hole can be drilled in the oyster's shell or soft tissue can be rapidly eaten away.

Observations and investigations indicate that snails may eat any small animal fixed to the seabottom. According to Butler (1953) the snails food in the order of preference is mussels, oyster spat, barnacles, clams, hydroids and finally large oysters. This order of preference is in agreement with the findings of the writer in 1937, 1956 and 1957.

The site and exact method used by *Thais* in drilling and feeding on oysters has provoked much discussion. Our investigations lead us to believe that the following is the usual procedure.

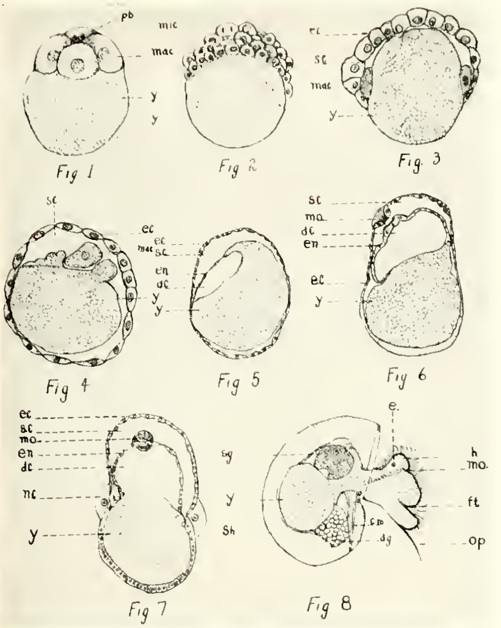
1. Adult snails attacking oysters of any size with well developed shells prefer to drill at the lip of the shell. Data gathered by the writer in 1937 and again in 1957 substantiates the findings of Butler (1953) which indicates that 90% or more of the oysters are attacked at the edge of the shell. Furthermore, evidence of drilling at the lip is very difficult to detect after the oyster is eaten, thereby making it highly improbable that the extent of snail damage to an oyster bed can be determined by the examination of old shells. (See Plate I).
2. Young snails, under 15 mm. in length, attacking small oyster spat are much more likely to drill directly through the shell and in some of our experiments all of the oysters were drilled high on the shell rather than at the lip.
3. How the snail kills the oyster after drilling through the shell is not well understood. Possibly chemicals are used to inactivate the oyster or vital organs may be attacked at first. In any case, shortly after the snail gains entrance into the shell the oyster gapes slightly and those snails near the lip quickly extend their proboscides into the open lip and begin to feed. Observations made at this laboratory indicate that several snails may attack and feed on a single oyster simultaneously.
4. At least one observation made here indicates that snails may attach themselves on or near the oyster lip inserting the proboscis into the shell when the oyster opens to feed. In the case observed five snails were attached to the lip of the oyster with their proboscis extended into the shell. Examination proved the oyster to be alive and upon disturbance it closed tightly on all the extended proboscides and trapped the snails.
5. Some investigators believe that once a snail kills an oyster in the field secondary predators may enter the shell and consume most of the meat thereby forcing the snail to kill more oysters than would seem to be necessary to supply its demand for food. Actual studies of *Thais* feeding on oyster meat were made in this laboratory. Oyster meat was placed between slightly spaced microscope slides and small snails (15 mm.) were allowed to feed. They quickly inserted the proboscis between the slides and attacked the meat. Observations made with the dissecting microscope indicate that the consumption of soft oyster meat is very rapid and apparently eaten first. Oyster muscle and tough parts are eaten last but still more rapidly than would be expected. It is estimated that, at least in small snails, they can consume a volume of soft oyster meats equal to the size of their own body in a matter of 10 to 20 minutes. Furthermore, it is surprising that a snail so small can consume the volume of meat eaten.

The amount of oysters from 2 inches to market size consumed by snails on any one bed or in any one area is difficult to determine. Butler found that adult snails could consume oysters at the rate of 10 to 15 per snail per month in the laboratory. If such a rate can be applied to field conditions the losses on oyster beds could become staggering. Our investigations indicated a slower feeding rate but this may have been due to a difference in methods used to study feeding. There is certainly a difference in the feeding rate when the size of the oyster is considered. One to two inch oysters are eaten five times faster than three to four inch oysters. Newly set spat have been observed to be destroyed almost totally in lower Barataria Bay and in many instances the new oyster set is consumed by tiny snails which set about the same time. From our observations it seems evident that the annual oyster set in the more saline areas of Louisiana is almost totally destroyed by the oyster drill.

Reproduction and Growth

Thais is a dioecious snail, males and females occur in approximately the same numbers and may be distinguished from each other by the S shaped penis in the male which is located on the right side of the cephalic hump. Breeding and egg laying is controlled largely by water temperature. After the water reaches 20° C gonadal activity begins with the formation of eggs and sperm. Egg laying commences some 25 to 30 days later which usually is in March. The height of egg laying is in April and May and egg deposition ceases in the summer months when water temperatures approach 30° C. During mild winters egg laying starts earlier and eggs have been found by the writer as early as January and February. Eggs are deposited in capsules which are cemented to any firm object that will keep the egg capsules away from the bottom. One hundred and fifty or more capsules may be layed by a single female at one egg laying and each capsule contains from several hundred to a thousand or more eggs. (See plate I). Butler reports large egg capsules contain up to 4000 eggs and in one case he estimated that 250 snails deposited 100 million eggs in one month.

Development of the egg takes place within the capsules. Several embryonic stages are passed through during a 12 to 16 day incubation period after which small larval, free swimming snails leave the capsules and take up life in the water. (See Plate II). The exact length of embryonic development in the egg capsule is controlled by temperature. Low temperatures slow the process and prolong incubation. Little is known of the free-swimming snail larvae. Apparently they are at the mercy of the tide and weather for several weeks after which they set and take up a crawling life on the bottom. At the time of hatching the tiny larvae are about 0.15 mm. in size and they grow from 0.8 to 1.0 mm. before setting. Even such tiny snails, about the size of the head of a pin, began to feed on new set oysters.



LARVAE STAGES OF OYSTER DRILL
THAIS HAEMOSTOMA (Plate II)

Note: All drawings are semi-diagrammatic camera lucida reproductions from stained material. X180

1. Egg after nine hours of incubation. Second cell-division has taken place so that now there are four large cells (macromeres) lying superficially on the yolk.
2. Egg stage after 25 to 30 hours of incubation. A cap of cells overlying yolk, the macromeres covered by fast dividing small cells (micromeres).
3. Optical section of early blastula stage, 30 to 35 hours after incubation. Note segmentation cavity* and epibolic growth of ectoderm.
4. Optical section of completed blastula 50 to 60 hours of incubation*. Note segmentation cavity and macromeres.
5. Optical section of the beginning of gastrulation** 70 to 80 hours of incubation. Note formation of digestive cavity.
6. Optical section of late gastrulation showing mouth formation and beginning of trochophore** stage, after 100 hours of incubation.
7. Trochophore stage after 100 hours of incubation.** Note shift in mouth position, lack of floor to digestive cavity, and large nephridial ("kidney") cell.
8. Free-swimming veliger stage after 200 or more hours of incubation. Note shell.

ABREVIATIONS:

y.	Yolk	h.	Head
pb.	Polar Bodies	op.	Operculum
mic.	Micromeres	s.c.	Segmentation Cavity
mac.	Macromeres	d.c.	Digestive Cavity
ec.	Ectoderm	n.c.	Nephridial Cell
mo.	Mouth	s.g.	Shell Gland
sh.	Shell	c.m.	Retractor Muscle
e.	Eye	d.g.	Digestive Gland
		ft.	Foot

*Figs. 3 and 4. Camera lucida drawings to the same scale; larger size due to stretching in fixation. Figures selected to represent a typical formation of blastula in prosobranchiates.

**Figs. 5, 6 and 7. Ciliation of ectoderm not shown because of the staining technique used.

Studies of the development and larval stages of the oyster drill are important because it is the weakest point in the life cycle. Chemical or electrical control would have the most effect if directed at this phase of the life cycle since millions of the snails are vulnerable while in egg cases or as delicate larvae.

Growth of *Thais* after setting is rapid but depends upon water temperature and food. During warm periods and with an abundance of food, Butler (1953) has found that they can grow one inch the first month and may reach two inches in five months. Our investigations of growth indicated a rate of approximately 10 mm. per month in cool weather without an excess of food. During winter the growth slowed to about one mm. per month. The growth rate slows as the snails get larger.

Possible Control Methods

Control of oyster drill populations has been a problem considered by many investigators and as yet no efficient method has been found. It is generally agreed that the controlled introduction of fresh water into snail infested saline areas would be the most effective method to employ but such would involve costly engineering procedures. The use of chemical poisons or electricity is a definite possibility particularly if control is directed at larval stages. Investigations of this type are now under consideration at this laboratory.

Oyster and Oyster Drill Setting Investigations

A great deal of work has been published on the setting of oyster larvae, larval levels in plankton samples and factors controlling oyster set. Much of this work has been done in areas away from Louisiana and is not directly applicable here. The specific aim of these investigations is a practical one. It is necessary to know at what times of the year oyster larvae reach high levels in Louisiana waters in order that the time of shell plantings can be fixed to receive an adequate catch before fouling by marine organisms occurs. It is generally known that the spring peak of oyster setting occurs in April, May and early June but the exact time of a fall and winter set, if one occurs, is not known. It is also true that the oyster drill, *Thais*, breeds about the same time in the spring as does the oyster. Little is known of the setting time of snail larvae in relation to oyster set and such information could be of importance because new set snails actively feed on new set oysters.

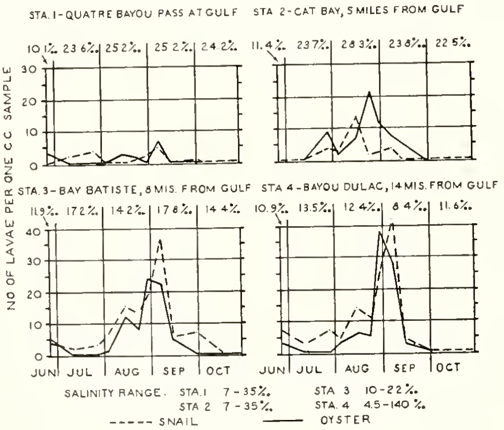
With these aims in mind, snail and oyster larval counts were made every two weeks at four stations at intervals from near the Gulf to 14 miles inland. Oyster set was also studied at these stations. These studies were initiated in June 1957 and were complicated by two unexpected factors; (1) high waters from the Mississippi which reduced salinities in the lower bay region near the Gulf where high salinities are the rule and (2) two hurricanes which caused extreme tides and unusual salinity conditions over the entire area. The preliminary results presented here, in our opinion, probably do not represent the usual condition but point up clearly the need for more information concerning these biological factors.

Graph VII illustrates the results of biweekly oyster and oyster drill larval counts in plankton samples. It is clear that an increase occurs in both oyster and *Thais* larvae in late August and early September. Furthermore the density of both types of larvae are greatest at stations three and four which are areas of moderate or low salinities located farthest from the Gulf. This pattern is the expected one for oyster larvae and indicates clearly that a late summer or fall set of oysters did occur.

The pattern of snail larvae density, however is not the expected one. The cause of such a late peak density of snail larvae is not clear since it is generally understood that they reach a breeding peak only once during the year in March, April and May. Observations during the early part of the summer, however, failed to indicate a successful snail hatch or set and this was attributed to the fact that lowering of salinities by river water prevented successful hatching in the normally saline lower bay area. If such was the case residual breeding once the waters returned to normal salinities in mid summer may explain the late rise in larvae. Certainly many examinations failed to reveal a new set of snails anywhere in Barataria Bay until September and then only a few were found. The higher density of snail larvae occurring at stations three and four is not easily explained. It is possible that unusually low salinities (10 parts per thousand) in the lower bays inactivated or killed the adult snails so that they did not respond when salinities returned to normal and few managed to breed. On the other hand, during the periods of low salinity at stations one and two hydrographic data indicate that higher saline waters were trapped in the upper bay near station three. Snails remained active here when none could be found at station one and few at station two during April, May and June. Although the salinity eventually dropped to 12 parts per thousand at station three, it was for only a short period in June and very likely this was the only one of the four stations that furnished near optimum conditions for *Thais*. This being the case, heavier breeding could be expected in this area.

While the above explanation may suffice to explain high snail larval counts at station three it does not explain the very unexpected high density at station four. Station Four, in Bayou Dulac, is a low salinity area and adult snails have never been found in the area. This is expected since salinities most of the year are below the tolerance level for *Thais* and it was assumed that it was too low to allow snail larvae to exist for any length of time. The presence of snail larvae at station four may be explained by current movements which carried them from the region of station three but their apparent ability to survive for any length of time below 12 parts per thousand needs further investigation.

GRAPH VII - DENSITY OF SNAIL AND OYSTER LARVAE IN PLANKTON SAMPLES



In the future it is expected that the methods used in this investigation will be refined and data will be collected for several years until a definite larval peak and setting pattern is established for both the oyster and the oyster drill, *Thais*.

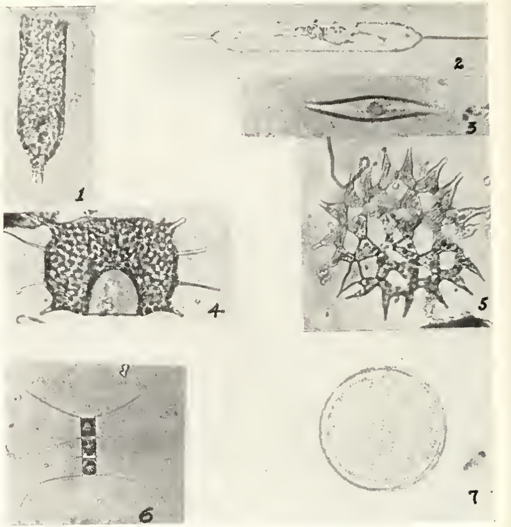
Oyster Food Investigations

The principal food of oysters are various species of one celled plants which are found floating at random in sea water. The broad category of such water borne minute plants and animals is known as plankton. That portion of the plankton which consists of tiny living animals is known as zooplankton and that which is made up of plants is known as phytoplankton. Since all plankton is water borne its movements over great distances and distribution at any time is almost solely controlled by tidal and wind currents. The amount of plankton and the kind of plankton occurring at any one place or at different seasons of the year may vary greatly because of environmental conditions. Changes in salinity, water temperature and the amount of dissolved nutrients present in the water all affect the amount of phytoplankton available in the water to serve as oyster food.

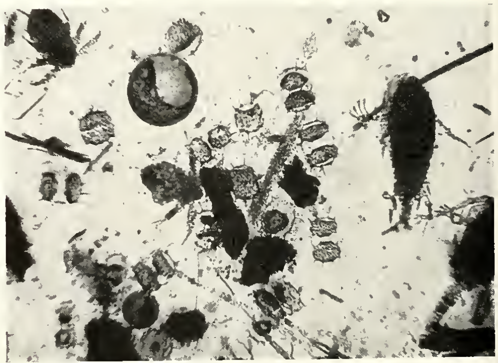
In studying the availability of phytoplankton for oyster food in Louisiana waters it is necessary that the following information be gathered:

1. The different types of phytoplankton occurring in the area must be determined.
2. The distribution and density of the various types must be understood.
3. Those factors such as salinity, water temperature, nutrients and water currents affecting the density

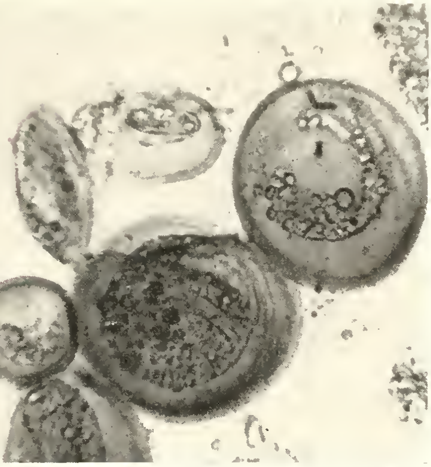
PLATE III. OYSTER FOOD ORGANISMS



1. A one celled animal in its cone-shaped case, *Tintinnopsis* sp. 0.0002 inch. 2. A symetrical one-celled plant commonly called a diatom, *Ditylum brightwelli* 0.0004 inch. 3. A diatom, *Pleurosigms* sp. 0.0002 inch. 4. A diatom, *Biddulphia mobiliensis* 0.0002 inch. 5. A colony of one-celled plants, *Pediastrum simplex* 0.0002 inch. 6. A diatom, *Chaetoceros* 0.0002 inch. 7. A diatom, *Cosinodiscus* sp. 0.0002 inch.



A photomicrograph of various types of oyster foods. Approximately X 250.



A photomicrograph of cultured specimens of *Dermocystidium marinum*, the fungus involved in summer oyster mortalities.

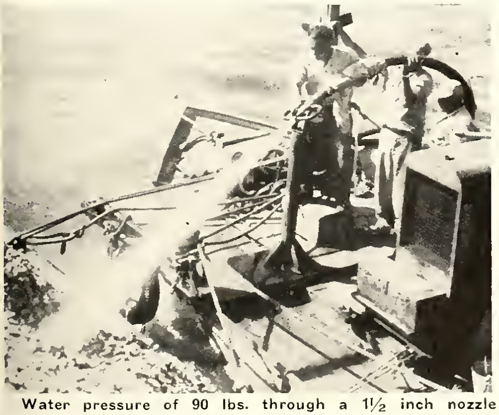
and distribution must be determined and correlated with the type and distribution of oyster food.

Oyster food investigations planned by the biological section include the above phases of work.

At present the preliminary work has been completed and most of the types of phytoplankton which are abundant enough to serve as oyster food have been identified. Typical species of this group are shown in plate III and photograph 13. Some data has been gathered on the occurrence of different types of phytoplankton during different seasons of the year and in waters of different salinities. Thus far the data is not complete enough to make an analysis but there is some indication the phytoplankton (oyster food) may totally disappear from some areas of low salinities during mid summer. Such an absence of phytoplankton has never been noted by us in areas of high salinity. Studies along these lines are being continued.

Investigations of Steam and Reef Oyster Shells as Oyster Cultch

Louisiana normally plants some shells annually for the purpose of restoring depleted reefs and to establish new areas where seed oysters can set. In most instances the shells planted are clean steam plant shells returned to the State by Mississippi canneries. In recent years the return of shells has ranged from 30,000 to 50,000 or more barrels annually. From time to time these plantings have been supplemented by the purchase and planting of additional shells. In such instances, purchased shells were either clam shells or clean steam shells. During the Spring of 1956, the Oyster Division had an opportunity to purchase freshly dredged reef (mud) shells at a nominal cost which would make a large scale planting economically sound provided such shells were suitable for



Water pressure of 90 lbs. through a 1½ inch nozzle mounted on a pedestal makes an effective instrument for washing shells overboard.

Preparing marker stakes to indicate boundaries of areas to be planted with shells.

Steam shells are deposited overboard by hand from a Mississippi oyster boat.

Preparing to unload a barge of reef shells for oyster cultch.

Shells are blown overboard by high pressure water hoses. Such a system scatters the shells in an even layer on the bottom.

cultch. Discussions of the use of reef shells were had with various biologists and there seemed to be a divided opinion as to their suitability. Gunter (1936) reported some successful oyster sets on mud shells in Texas waters. In view of the low cost of operation it was decided to carry out a relatively large scale planting of both steam and reef shells as an experiment.

Type of Area Planted

An area of 813 acres was selected for planting. The bottom was primarily very hard clay mud with little or no over lying ooze or slush. A portion of the area consisted of an old depleted reef. In past years this was considered one of the finest seed areas in the state but eventually it had been dredged clean.

Method of Planting

All reef (mud) shells were planted from barges by spraying with a high pressure water hose. This method afforded a controlled and even distribution of the shells. Approximately 39,000 barrels of reef shells were planted on 335 acres of hard mud bottom and an additional 12,000 barrels were planted on 190 acres of hard mud and old reef. Clean steam shells were planted from boats by hand and the distribution was less even than in the case of the reef shells. Approximately 20,000 barrels of this type shell were planted on 115 acres of very hard mud bottom. All areas were adjacent to each other in an open bay with water depths ranging from four to seven feet.

Results of Planting

Plantings of both reef and steam shells commenced on May 5, 1956, and were carried out simultaneously in adjacent areas. All steam shell plantings were concluded by May 25th, but reef (mud) shells were planted until June 10, 1956. Examinations of shells and plankton samples several times per week indicated a peak spat fall had occurred between May 1 and May 15th, after which time the spat fall declined rapidly. Early sets on both types of shell during the heavy spat fall were extremely heavy ranging from 50 to 200 or more per shell. A comparison of the early set on each type of shell, however, indicated that a greater percentage of the steam shells were showing catches and that the individual shells contained more spat. During the light spat fall the same differences were noted. It should be understood, however, that the spat fall on both types was successful and that the heavier catch on the steam shells might result in over crowding.

On July 20th, some 75 days after the initial planting a count was made of the surviving spat which now ranged from .5 to 1.0 inches in size. The results are summarized in tables IX, X and XI. Data summarized in table IX indicates a distinct difference in the ability of reef and steam shells to catch an oyster set, with reef shells showing less efficiency than steam shells. This difference appears to be caused principally by variations in the size ranges of the two types of shell. Examination of the data in table X will show that there is no significant difference between the ability of the two types of shells to catch oysters in size groups greater than 1.0 inches. Below one inch in size neither type of shell succeeded in catching oysters with any degree of efficiency. Since reef shells contain a much larger percentage of small flat broken pieces less than one inch in diameter, it is reflected in the lower overall average set indicated in table IX. The reason for failure of small pieces of shell to catch a set was not determined. It might be that a thin layer of silt or slush on the bottom may effectively bury these small flat pieces of shell and prevent setting.

TABLE IX. Comparison of set on steam and reef shells.

Type shell	Percent of shells catching—heavy set	Percent of shells catching—light set
Reef or mud shells	56.0%	33.0%
Clean steam shells	73.0%	53.0%

TABLE X. Comparison of set on steam and reef shells according to size.

		Percent of catch on various size shells		
Type Shell	Set intensity	0 — 1 in.	1 — 2 in.	2 + in.
Reef	high	0.71%	60.0%	92.3%
Steam	high	0.00%	63.8%	82.6%
Reef	low	0.00%	16.6%	46.4%
Steam	low	0.00%	22.2%	64.5%

TABLE XI. Average number of spat per shell in various size groups.

		Avg. No. of spat per shell			
Type of shell	Set intensity	0 — 1 in.	1 — 2 in.	2 + in.	Average all sizes
Reef	high	1.3	3.9	13.3	8.8
Reef	low	0.0	1.6	3.4	3.2
Steam	high	0.0	3.5	17.0	15.0
Steam	low	1.0	4.5	10.4	9.8

The average number of spat varies with shell size (table XI) and it appears that steam shells are more efficient than reef shells in collecting spat per unit area. This is particularly true during low intensity spat-falls. Here again, however, the difference reflected in the overall average for all size groups may be a result of the amount of shells in each size group occurring in a random sample rather than an actual difference in the efficiency of the two shell types.

After one year, in August 1957, a reexamination of the areas was made to determine if the oysters were of suitable size to dredge for seed. Counts were made of the number of shells having seed oysters and the number of seed per shell. The results of this examination is shown in Table XII.

TABLE XII

A Comparison of Set on Steam and Reef Shells One Year After Planting

Type of Shell	Percent of Shells with Seed Oysters	Number of Seed Per Shell	Number of New Spat Per Shell
Reef	73.0	3.1	3.2
Steam	84.0	5.2	......*

* Crowding of oysters on steam shells resulted in some mortality (30%) and new spat were not counted because of crowding.

It is evident from Table XII that after one year both types of shells had successfully produced seed oysters. Percentage wise steam shells were about 10% more efficient in catching but this advantage may be reduced when the quality of the seed is considered. The greater number of seed per shell (5.2) on steam shells resulted in crowding

Crowding caused the seed oysters to be less well formed and resulted in some mortality amounting to 30% in some cases. Seed on the reef shells were well formed and separated. New spats from the spring of 1957 were evident on most shells.

In general seed production over the entire planted area was good to excellent and the area was open to dredging in September 1957. Many oyster growers took advantage of this fact and during the first week of dredging some 100 boats removed over 80,000 barrels of seed. Continued sporadic dredging after the first week produced possibly another 20,000 barrels.

In February 1958 another examination was made in the area, the results of which are listed in Table XIII.

TABLE XIII
Amount of Seed Oysters and Spat On Remaining Shells Aftr Dredging

Station No.	Type of Shell	Per Cent of Shells with Seed Oysters	Per Cent of Shells with Fall and Winter Spat
1	Reef	89.0	66.0
2	Reef	80.0	57.0
3	Steam	100.0	100.0*
4	Steam	76.0	84.0

* Small Sample.

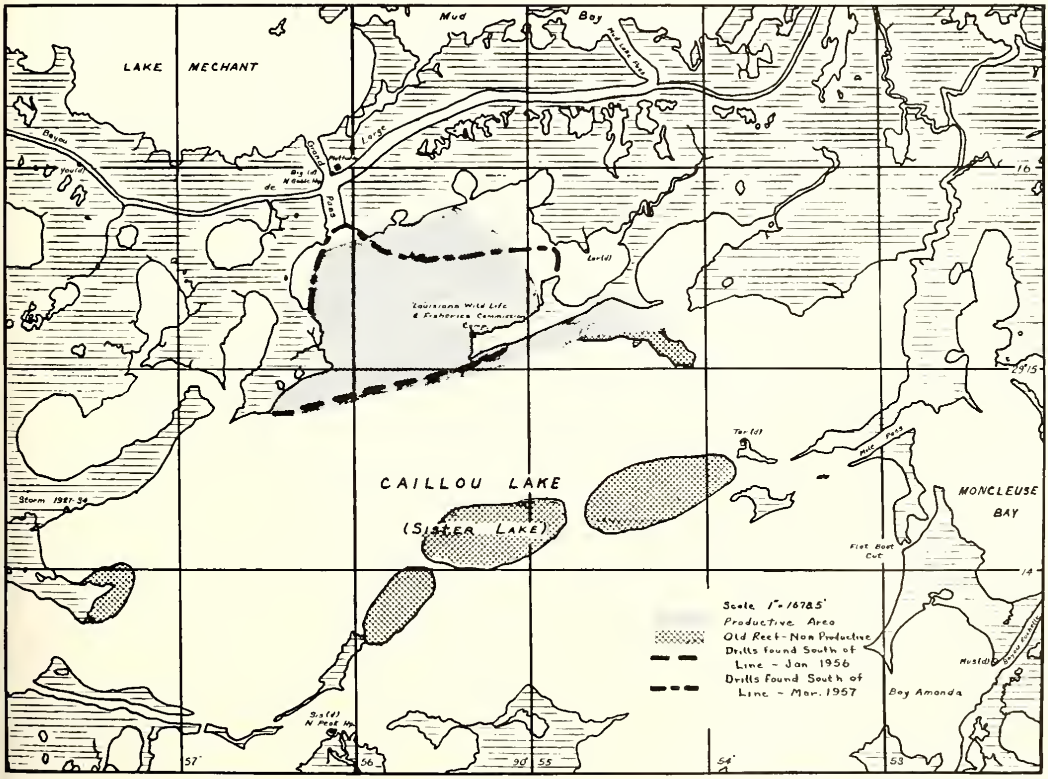
Results of the post dredging examination shows about the same per cent of shell to have seed oysters and shows evidence of a significant set of young oysters during the fall and winter. It took considerable dredging effort to collect samples which indicates that only a small per cent of the original planting is left in the area after dredging.

Conclusion

It is evident from the above results that reef or mud shells are suitable for oyster cultch provided that the bulk of such shells are greater than one inch in size. The per cent of catch while slightly less on reef shells than on steam shells is compensated for by the better quality of seed which is produced.

A Report of Oyster Condition and Production in Sister Lake 1956-1958

Sister Lake (Caillou Lake) located in Terrebonne parish was set aside as a seed oyster area in 1940. At the time of it's establishment as a reservation the lake was an outstanding seed-oyster producing area and possessed all of the ecological characteristics necessary to maintain a high seed production. After 1951 ecological changes, involving startling increases in mean salinities, have been recorded in the lake. Accompanying these changes oyster predators (snails) and disease *(Dermocystidium marinum)* have had a drastic effect on oyster production. For example in January, 1954, production was 90,000 bbls., in 1956, after two years without dredging, production dropped to 20,000 bbls., in 1957, production dropped to 11,000 bbls. and recent studies of the area indicate that only 4,500 bbls. may be expected in 1958. It is also evident from studies over the past three years that the actively producing areas of the lake have been greatly reduced and are now confined to a small bay of approximately 600 acres on the northwestern corner of the 7000 acres lake. The following report considers the detailed data on oyster condition and production in Sister Lake from 1956 to 1958.



Location and Extent of Present Oyster Production

Sister Lake is a typical marsh lake located in the marshes of lower Terrebonne Parish. It is an irregular oval in outline approximately five miles long on its east-west axis and 2/5 to 3 miles wide on the north-south axis. Its approximate area is 7000 to 8000 acres. It lies in the drainage basin of Bayou de Large from which it receives most of its fresh water. It is also joined on the north by Grand Pass to Lake Mechant. The outlet from the lake to the Gulf is through Grand Bayou de Large at its west end and Bayou Grand Caillou on the east.

The water depth varies from 1 foot to 6 feet over most of the lake except in the main channel which runs from Grand Pass on the north side the lake across its western end to Grand Bayou de Large. The bottom is principally of mud except for areas of natural and planted reefs (see map). There is much evidence that Sister Lake was once an excellent oyster producing area. In recent years, however, the eastern and southern half of the lake has become less and less productive until at present there are few if any live oyster reefs to be found south of a line running from Walker's Point on the western shore of the lake to the long point on which the Wild Life Commission Camp is located. In fact, practically all of the oyster production in the lake is confined to the small bay in the north end of the lake formed by these two points (see map). In this area it is estimated that between 600 and 650 acres of the lake bottom is producing oysters. Two small areas of productive bottom were found in the main body of the Lake. One of these lies along the north shore of the main body of the lake about ½ mile east of the camp and the other around the point near Bay Voisin (see map).

Comparison of Condition, Size and Density of Oysters in Sister Lake 1956-1958

The method of sampling in Sister Lake consisted of collecting at marked stations so laid out as to give a representative picture of production over the entire area. Data at each station was recorded to show total live oyster production per bushel of total dredged shells. Measurements and counts were made of all live and dead oysters in order to determine density and condition in each size and age group.

A rather intensive examination of the lake was made in July of 1955 in order to determine which areas of the lake were producing oysters and to set up permanent stations. Table XIV lists the findings in this preliminary examination.

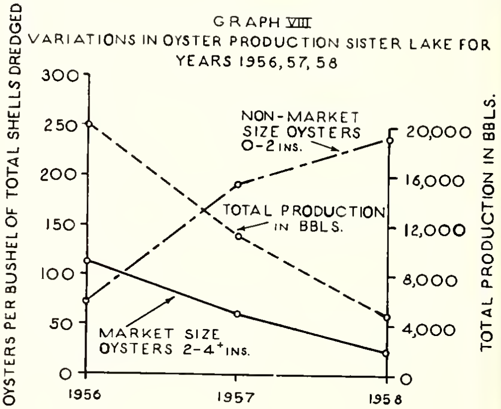
TABLE XIV. Dredge Sampling showing density of Oysters 7/8/55.

Location of Sample	Salinity P.P. Mille	Live oysters No.	Live oysters Bush.	Shells Bu.	No. Drills	Drill Eggs
Old Ree SE. of Camp	22.2	7		2.78	14	Yes
Old Ree S. of Camp	20.8	0		1.00	6	Yes
Shore West of Camp (Walker's Point)	19.0	561	1.00	1.00	3	No
N. End of Lake on planted shells	18.0	474	1.30	2.80	0	0
Front of Camp Near Channel	20.6	568	1.20	1.05	0	0
Bay NE. of camp Planted shells	17.8	293	0.85	1.00	0	0

It was evident from this preliminary work that the extent of oyster producing bottom in the lake was quite small when compared to past years and that it was gradually being reduced by a northward movement of oyster drills as salinities increased. For example, in Table XIV only seven live oysters were taken in several hours of dredging on the natural reefs in the main body of the lake South and Southeast of the Wild Life Camp (see map) where once most of the production occurred. On the other hand, from Walker's Point north and in the 600 acre bay in the Northwest corner of the lake production ranged from 300 to over 500 live oysters per bushel. During the three year study since 1955 this small area north of a line from Walker's Point to the Wild Life camp has been the only area in the lake producing oysters in significant numbers, and even in this area production has declined alarmingly.

Table XV is a comparison of data summarized from each station in the production area of the lake for 1956, 1957 and 1958.

An examination of table XV will show that total oyster density had varied insignificantly from station to station over the three year period but that a marked shift has occurred in the density in each size group. This shift shows that the total number of market sized oysters available for harvest has declined sharply. These changes are more clearly


GRAPH VIII
VARIATIONS IN OYSTER PRODUCTION SISTER LAKE FOR YEARS 1956, 57, 58

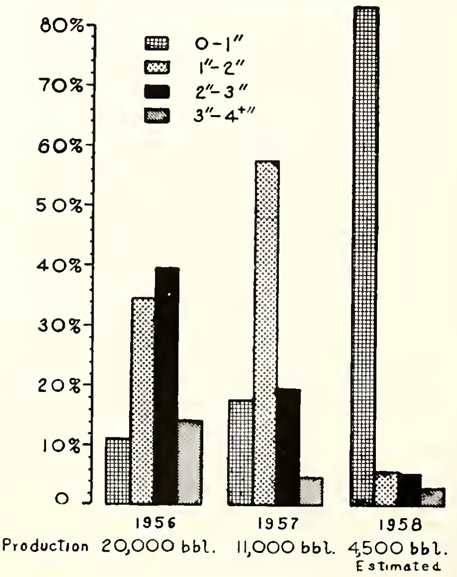

GRAPH IX
PERCENT OF OYSTERS IN EACH SIZE GROUP 1956-58

TABLE XV. Production at various stations in Sister Lake

Location	Year	No. of Samples	Size, Range & No. Live Oysters 0-1″	1″-2″	2″-3″	3″-4″	% Mortality	Bushels of Shells
N. shore Pt. on which camp is located	1956	2	1	13	29	24	3.0	.25
	1957	1	1	21	24	9	12.7	.10
	1958	2	48	34	42	16	11.9	.95
Along shore E. of Grand Pass	1956	2	0	0	0	0	0.0	.00
	1957	1	9	146	80	11	9.2	.10
	1958	2	169	21	15	5	10.6	.70
Between Camp and Grand Pass	1956	3	8	40	42	22	0.0	.75
	1957	1	24	145	31	7	24.2	.40
	1958	2	121	3	5	2	14.9	.50
In Front of Camp West to Channel	1956	3	20	50	68	21	0.0	.33
	1957	1	116	125	1	1	24.5	.25
	1958	5	394	31	17	5	20.7	1.70
Shore West from Walker's Point	1956	4	11	58	113	16	0.0	.50
	1957	1	21	71	24	6	30.7	.50
	1958	1	89	0	0	1	21.7	.50
West Shore from Walker's Pt. to Grand Pass	1956	3	27	66	11	6	1.9	.40
	1957	1	12	117	63	22	8.5	.30
	1958	7	904	78	79	29	10.8	2.70
Shore from Camp Pt. to Butterbean Bay	1956	..	0	0	0	0		
	1957	..	0	0	0	0		
	1958	7	296	1	5	16	33.7	2.15
			Non-Market		Market			
	1956	18	86	258	296	95		4.5
	1957	7	206	674	226	60		17.5
	1958	2.6	2021	168	163	74		17.2
			0-1	1-2	2-3	3-4+		
Percent of oysters in each oyster group	1956		11.55%	34.62%	39.86%	13.97%		
	1957		17.66	57.80	19.84	4.70		
	1958		83.40	6.90	6.7	3.0		

seen in Table XVI, Graph VIII and Graph IX. In table XVI note that total oyster production per bushel of shells has varied little and has shown a slight increase in 1957 and 58, but of considerable significance is the great drop in market oysters per bushel and the corresponding rise in the non-market group. This drop in market size oysters is reflected by a similar drop in total production for the lake from 20,000 bbls. in 1956 to an estimated 4,500 bbls. in 1958. (See Graph VIII). Shifts in each size class have been definitely downward in size from year to year since 1956. For example in 1956 small oysters (0-2 inches) made up only 45% of total density. But in 1958 small oysters made up 90% of all oysters. (See Graph IX.)

Several facts become apparent from these data, as follows—

1. Dredging of oysters helps rather than hurts oyster setting as indicated by the great increases in very small oysters in 1957 and 1958. (Graph IX.)
2. Dredging late in the spring may be more effective in aiding oyster setting since the greater amount of set evident in 1958 followed dredging in April of 1957 whereas the set of 1957 followed dredging that occurred in January, February and March of 1956. Other ecological factors such as temperature and salinity may have been involved.
3. It is evident from a careful examination of data in table XVI that a much greater loss in oysters, that should have grown to maturity, occurred between the 1957-58 seasons than occurred between 1956 and 1957. For example, a density of 71 spat and small oysters per bushel in the spring of 1956—produced a density of 62 market sized oysters 12 months later in the spring of 1957. This reflects a 12.6% mortality from all causes over the summer of 1956. By comparison, a density of 191 small oysters per bushel in January, 1957 produced a density of only 25 market oysters per bushel in 1958. This reflects an 86.9% mortality from all causes during the year 1957.

Discussion of Factors Influencing Oyster Production in Sister Lake

The gradual decline of oyster production in Sister Lake since its establishment as a seed ground is basically the result of a rapidly changing ecology; in particular the great increase in mean salinities which have occurred since 1953. Table XVII shows clearly that after October 1953 salinities were generally well above 14 parts per thousand a point above which oyster drill populations become large enough to cause serious predation. This change is marked by the fact that no production of significance has occurred in the main body of the lake south of a line from Walker's Point to the Wild Life camp since 1954. (See map) This line between productive and non-productive areas marked the northern most migration of the oyster drill population in July 1955. Between 1955 and 1958 drills have moved into

TABLE XVI. Variations in total market and non-market size oyster production — Sister Lake 1956-1957-1958

Year	Total bu. of samples	Total Oysters	Oysters per. bu.	Total No. non-market Oysters	Non-market oysters/bu.	Total No. Market Oysters	No. Market Oysters/ Bu.	Production of Lake
1956	6.3	1161	185	446	71	715	113	20,000 bbl.
1957	4.6	1166	253	880	191	286	62	11,000 bbl.
1958	9.2	2426	265	2189	238	327	25	4,500 bbl. est.

TABLE XVII. A comparison of average monthly salinities in Sister Lake. Nov. 1950 - Dec. 1955

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1950											14.0	11.5
1951	........10.5*	11.6	11.3	5.1	11.6	9.2	9.1	7.5	11.9	15.2	12.4	17.9
1952	........17.1	10.1	10.0	9.0	8.6	11.3	16.7	12.2	19.5	19.7	21.8	21.9
1953	........11.7	12.3	16.9	16.4	22.0	18.0	9.6	8.7	14.5	20.9	18.2	9.8
1954	........11.7	16.6	16.8	25.3	24.7	22.9	16.4	16.1	24.9	25.9	22.2	18.1
1955	........13.6	17.1**	22.3	23.0	17.8	15.9	15.1	10.4	17.2	19.5	19.3	18.8

* All salinities recorded in parts per thousand.
** Short data.
Note: Salinities over 14.0 parts per thousand allows invasion of the oyster drill (Thais).

practically all parts of the lake. Although there is some doubt that snail densities north of Walker's Point are significantly high, thus far, it is possible that they are a factor in the decline in production in 1957. It is evident that should salinities remain high and snail densities in the productive areas of the lake increase, production of oysters in the area from natural set may cease. High salinities have also allowed the oyster fungus *D. marinum* to become established in Sister Lake. Thus far it does not seem to be a significant factor in mortalities but could well become serious.

The cause of the increased salinities in Sister Lake seems to have come about because of a combination of factors. These include:

1. The possibility of increased salinities because of the recent dry weather cycle. If this cycle reverses itself lower salinities may be expected and the high rainfall occurring in 1957 tends to bear this out.
2. Changes in drainage may be the basic cause. Some evidence is available to indicate that flood control along the lower Atchafalaya River prevents backwater entering the lake and that local drainage is now diverted away from Bayou de Large.
3. The establishment by private landowners of a dam in one distributary of Bayou de Large which originally furnished fresh water to the eastern end of the lake.
4. A natural slow increase in salinity because of geologic changes and subsidence. This seems unlikely because of the rapidity of changes during recent years.

No doubt several of the factors are having an effect on Sister Lake. Without changing one or more it is impossible to determine which factor has had the most effect.

Success of Oyster Set

Oyster larve are present in great numbers in all parts of the lake during the breeding season and spawning success is not expected to vary significantly because of salinity. It is probable that a successful set occurs over most of the lake where shells are present but the young oysters are totally destroyed in the main body of the lake where the snail population is high. Considerable loss also may be occurring in the remainder of the lake. The total set is less in areas of no production because the existing shells are old and rotten and not too suitable for cultch. In areas of production fresh new shells become available for cultch as normal mortality occurs. Data presented elsewhere in the report indicate that dredging increases set. This is probably a result of the mechanical action of dredging which exposes buried shell and cleans exposed shells.

Probable Causes of Production Decline 1957-1958

Data collected in 1956, 57 and 58 (see Table XV and Graph VIII) indicate a drop in production annually from 20,000 bbls. in 1956 to 11,000 bbls. in 1957 to an estimated 4,500 bbls. in 1958. The decline of approximately 50% between 1956 and 1957 is apparently due to the fact that the 20,000 bbl. harvested in January 1956 represented 2 years' growth while the 11,000 bbls. in 1957 resulted from one years' growth of only a fair set in 1956. Mortalities were less than 13% over the year probably due to drill predation. The decline from 11,000 bbls. in 1957 to an estimated 4,500 bbls. in 1958 is not so simply explained. Table XVI shows that there were more than twice as many young oysters in the spring of 1957 than in 1956 which should have resulted in a marked increase in production in 1958 if the annual mortality remained at 13%. Mortalities of young oysters in 1957 rose to 86.9%, however, resulting in a very low density of market oysters in the lake at present. The cause of this mortality may be one or a combination of several factors—(1) greatly increased drill predation in 1957, (2) the effects of several violent hurricanes and (3) the effect of late dredging in 1957 during warm weather which may have killed the young oysters. It should be noted, however, that dredging the lake in January and February of 1956 did not result in unusual mortality of young oysters.

Conclusion

In the opinion of this investigator the following conclusions may be drawn:

1. Production of market sized oysters has dropped drastically during the past three years.
2. The estimated crop for 1958 is 4,500 bbls., an amount probably too small to warrant dredging.
3. The present density of spat and small oysters is the greatest of the past three years. If they are not disturbed by dredging and summer mortalities are low an excellent crop of seed oysters should be available in September and October of 1958.
4. If the lake is opened to dredging for market oysters early in 1958 all dredging should be completed before March 30, 1958.
5. Late dredging while aiding spat fall, may destroy the existing small oyster after the water temperature rises.
6. From the available data it would appear that opening the lake to dredging every two years instead of annually would give a better sustained yield of market oysters.

FUTURE MARINE BIOLOGICAL RESEARCH IN LOUISIANA

The great value of commercial seafoods, the worth of our sport fishery and the uniqueness of the marshes, Mississippi Delta and littoral areas along Louisiana's coast makes a large scale, long range marine research program mandatory if we are to learn how to manipulate and conserve these valuable resources. Such a program has long been needed by the State and had one been initiated thirty or more years ago many of the present ills of seafood industry might have been avoided. Since 1955 such a program has gradually been taking shape within budget limitations. Much yet

Temporary laboratory and living quarters built on barges have been used for the past two years.

needs to be done and the following discussion indicates things now in progress and immediate plans for the future.

Marine Laboratory

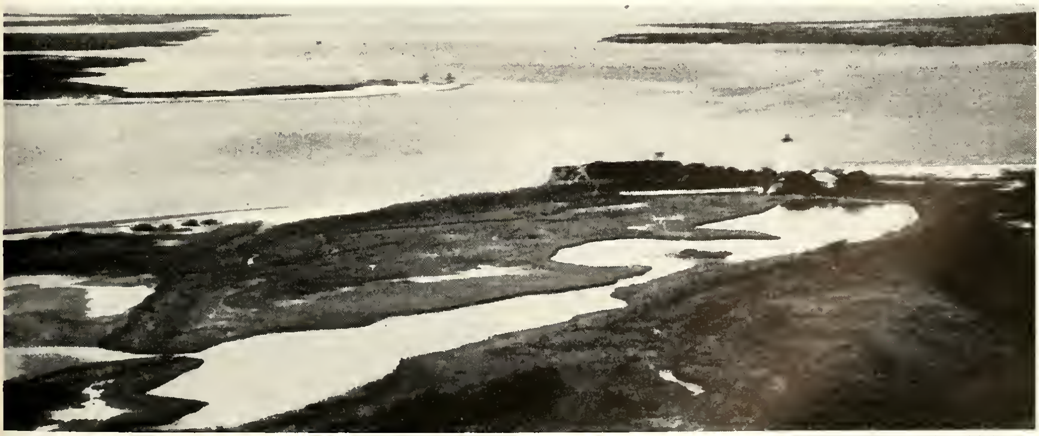
Louisiana's dire need of a modern, well equipped and staffed marine laboratory is finally being met. In December 1956 the Wild Life and Fisheries Commission was submitted a report pointing out three possible sites for a laboratory. The Commission selected a 100 acre site on Grand Terre Island adjacent to Grand Isle. This land had been deeded to the Commission by the Federal Government and is more or less centrally located in the oyster, shrimp, and sport fishery areas. The Commission directed the Biological section of the Oyster, Water Bottom and Seafood Division to proceed with planning and construction. During 1957 the following has been accomplished: (See photographs.)

1. The area was surveyed, mapped and all boundaries were officially established.
2. The old lighthouse keeper's house, a seven room dwelling, part of the property included in the deed has been renovated to serve as living quarters for laboratory personnel.
3. Plans were prepared for a boat canal, turning basin

Old lighthouse keeper's dwelling before renovation as living quarters for laboratory personnel.

Lighthouse keepers dwelling now renovated to provide living quarters.

Boat canal shortly after completion.



Air photograph of the general location of the new laboratory on Grande Terre Island. Note salt water ponds which will be utilized in the pond culture of shrimp and oysters.

Partially completed turning basin at new laboratory site.

and wharf. These were submitted for bids and this work is complete.

4. Dirt from the turning basin has been used to prepare an elevated site of some two acres and an additional five acres of land will be cleared and leveled for the laboratory site.
5. Plans, specifications, and estimates have been prepared for supplying electrical power to the site and are ready for bids.
6. Complete plans for the laboratory building, its salt water system and basic equipment have been approved and will be submitted for bid in the near future.
7. The biological section has moved its temporary laboratory to Grand Terre and has been in operation there since November 1957.

With completion of the laboratory building in the near future and if adequate equipment and staff can be provided, Louisiana will have taken a great step toward modern technical conservation of its marine resources.

Future Marine Investigations

The mass of research needed to be done in marine biology, hydrography, sedimentation, bacteriology, and biochemistry in the Louisiana area precludes listing it in such a report. Some of the research necessary in future years cannot be planned until basic work has been completed. Listed below is an outline of some of the work definitely needed in the foreseeable future.

1. A continuation and intensification of investigations already in progress and discussed elsewhere in this report.
2. Microbiological and epidemiological investigations of the oyster fungus *D. marinum* with emphasis on prevention or control.
3. Hydrographic studies directed toward understanding coastal ecology and developing our knowledge to properly control the introduction of river water into saline areas.
4. Studies of oyster foods and the factors controlling them.
5. Geological, hydrographic, and sedimentation investigations of canaling and dredging in coastal areas.
6. Investigation of the effects of various types of pollution on growth, mortality and condition of oysters.
7. Intensive efforts toward determining means of controlling the oyster drill, *Thais*.
8. Development of pond culture methods for oysters and shrimp. Controlled production of these types of sea food is definitely possible and may be the principal means of supplying the market in years to come.
9. Successful pond culture of oysters will lend itself to the development of fast growing varieties of oysters, the collection of seed oysters of a known age, and the development of disease resistant strains of oysters.
10. Little is known of the life cycles, migration patterns, food habits and growth of the various fishes supporting Louisiana's valuable recreational fishery. Work needs to be done in this direction.
11. Certainly investigations are indicated for the menhaden, crab, snapper, and lesser developed food fisheries.

The above list, by no means complete, serves to indicate the size and intensity that a research program could be developed toward. There is no question that extensive technical knowledge developed by the program outlined above would be of great economic value to the State and the returns in greater production and better conservation of our marine resources would pay for the cost of such a program a thousand fold. To develop such a program will involve considerable costs; costs will be higher initially since equipment, staff personnel and materials must be added to the present organization. Furthermore, it may be five to ten years after an intensive program is initiated, that noticeable headway in developing answers to various marine problems will be evident. In any event, in this day of modern technicological advancements and the need of feeding an expanding population, the State of Louisiana can wait no longer to initiate a sound long range marine investigative program.

Completed turning basin and near-completed dock at site of new dock. Laboratory will be built on wooded ridge at top of the picture.

Completed turning basin and temporary laboratory.

THE LOUISIANA OYSTER STORY

By Ednard Waldo

THE INNOCUOUS OYSTER which can neither fight nor run has somehow taken its place with the great in the recorded pages of history which proves the old adage that "you can't keep a good man down"—even if he's on the bottom of the sea.

History tells us the Roman emperors had fresh oysters transported to their banquets packed in bags of snow and Pliny says that as early as 95 B.C., one Sergius Orata became the first man to cultivate oysters by growing them on the bottoms of Lake Lucrinus. Horace, Seneca, Cicero praised the virtues and flavor of oysters in their writings. When the Romans conquered England they settled near oyster producing areas.

About seventeen centuries later we find our own early historian Antoine Simon Le Page Du Pratz telling of the excellence of Louisiana oysters he found here while devoting 16 years scouring our wilderness gathering material for his famous "Histoire de la Louisiane" published in 1734.

Of his initial encounters with the now world-famous Louisiana oyster, Du Pratz wrote 225 years ago, "In the Lake of St. Louis (Pontchartrain) about two leagues from New Orleans, the waters of which have communications with the sea and are somewhat brackish, are found several sorts of both sea fish and fresh water fish . . . Near the lake, when we pass by the outlets to the sea, and continue along the coasts we meet with small oysters in great abundance, that are very well tasted. On the other hand, when we quit the lake by another lake which communicates with one of the mouths of the river, we meet with oysters four or five inches broad, and six or seven long. These large oysters eat best fried, having hardly any saltiness, but in other respects are large and delicate."

But the early Roman oystermen and Du Pratz had nothing on our native American Indians who also knew the tasty oyster before the coming of the white men if we may take the word of scientists who recently examined remains of Indian oyster reefs uncovered by workmen excavating under a street in Boston. From the fossils found there archeologists have established the fact that these early Bostonians were consuming oysters at a great rate 4000 years ago. All of which means one thing: People have been enjoying oysters for some time.

Now consider the Louisiana oyster—succulent, delicious, with a world wide reputation for superiority which has been enormously improved by scientific methods of cultivation. Its importance as food has gone on increasing by virtue of the fact that it embodies all the elements that constitute a wholly nutritious and satisfying food.

There is no doubt about it; oysters are really remarkable. They grow in water, and not in the fields, yet oyster farming is a definite and involved process. They cannot swim about in search of food, yet oysters feed themselves and grow large and fat. They cannot run away from their natural enemies, yet can protect themselves amazingly well. They are at once commonplace and mysterious, simple and tricky. There are hundreds of scientists and thousands of men who spend their lives working on oysters. From the scientists to the oyster fishermen who plant their bed, the past hundred years of oyster cultivation has had a continuous history of encouragements and discouragements, of advancement and setback.

As said before the mature oyster has no power of locomotion and where it once settles, whether placed by nature or man, there it remains until removed.

A most interesting thing about the Louisiana oyster is its curious sex changes; an oyster usually begins life as a male, changes to female, then possibly back to male, and so on. This strange phenomeson is known as *protandric hermaphroditism* (*protos*; first: *andros*, a man; *Hermes*, a Greek god; *Aphrodite*—a Greek goddess—Venus). Perhaps a little more detail would help make this clear: A spawning oyster can definitely be identified as a male or female only after microscopic examination of the gonad—sex-cell producing organ. Presence of spermatazoa in the extract indicates that the oyster is a male, while presence of the eggs, of course makes it obvious that the oyster is a female.

Oysters in Louisiana can be found breeding from April until October and in isolated cases even during the winter months. This is why the breeding oysters are called "milky" because of the milky looking fluid they exude at that time. The milk of the female is composed of millions of minute eggs; that of the male of an incalculable number of extremely minute spermatozoa. A large female has been estimated to contain 60,000,000 eggs. This milk is cast out onto the water where the sperm of the male drifts or swims to the egg and penetrates it. This act of fertilization begins the cycle of oyster life. After fertilization takes place the egg divides again and again forming a ball of many tiny cells. In the course of a few hours, small vibrating hairs called "cilla" appear on the developing young oyster. With these cilla it keeps itself suspended while being drifted about by the winds and currents. Presently this embryo develops a pair of tiny shells. These shells grow larger and heavier and finally the young "spat", as the oyster is called in this stage drops to the bottom and attaches itself to some hard subject and gives up forever its own power of moving from place to place. The young spat can only attach itself to a clean surface, and after attachment while very small it is easily smothered by sediment and dies. This is why oystermen first lay beds of oyster shells as a foundation before planting the seed oysters.

The young oyster grows rapidly, and in the course of a few months becomes a tiny male. It does not become a female until the next year's spawning season and may not even then.

The oyster, because of its fixed position, is unable to go in search of food, and for that reason nature has so equipped this animal that it is able to obtain its food from the water in close proximity. The cells living in the syphon and the gullet of the oyster are equipped with hair-like cilla which beat and create water currents that carry to this animal the microscopic floating plants which form its principal food. In short the oyster "drinks" its food in a constant stream of pure clean water. A single oyster, feeding at a good rate, may pump water through its shell-cavity at the rate of 50 gallons a day. During the time the oyster is feeding itself it is straining or filtering many gallons of water a day, and in all that time its tissues are in a constant cleansing bath of pure, clean water.

Nine persons out of ten who have eaten oysters will tell you that they like oysters because they taste good. They like that zestful, tangy, salty and different flavor and let it go at that. Few know why or care less. There is an answer, however, and it's quite simple to the scientist: "The meat, the muscle sugar, the vitamins, the salts of the sea are present in oysters in just the right amounts and in just the right balance to stimulate the taste buds of our mouth in such a way that we are aware we are eating something enjoyable." It's just the right balance of chemicals, but the question is just where does

The oyster is a complete animal from the sea, the life giving sea, the home and life-blood of billions of living things. And the sea is important to the oyster, for the oyster is surrounded by it; the sea is almost the "blood" of the oyster; the water becomes part of the oyster, gives it calcium, iron, copper, phosphorous, potassium, chlorine, sodium and probably every chemical element; the water carries food to the oyster; the water brings oxygen; the sea is the medium into which the reproductive products are cast and in which the young oysters develop.

To the naked eye the oyster is readily seen to be composed of two different parts; the soft body-mass which we eat and enjoy as food and the shell which is outside that soft body and serves to protect it. The body is vital and energetic and carries on those activities which we describe as life—it takes in food, grows large and fat, it breathes, it provides for reproduction. The shell is essentially calcium carbonate and is non-living and has been deposited by the mantle, the outermost tissue of the body. The shell is in two halves or valves (one on either side) which are held together at one end by a tough, elastic hinge-ligament. This ligament acts as a spring, tending to force the valves apart. The muscle of the body, however, is attached to both valves and by contracting tends to pull the valves together. That is to say when the muscle contracts, it overcomes the force of the ligament and pulls the two valves tightly together. When the muscle relaxes, the hinge ligament forces the two valves apart.

The oyster "breathes" much like a fish, by a simple exchange of gasses. In the gills and the mantles are many, small, thin-walled blood vessels; the water flowing outside these blood vessels gives up some of its contained oxygen and takes on carbon dioxide, while the blood coursing within the vessels of the gills and the mantles receives the oxygen and rids itself of the carbon dioxide. The colorless blood of the oyster is pumped through all parts of the body by the small three-chambered heart of the animal.

As regards the breathing action of the mantle it may be mentioned here that this function is somewhat secondary to its primary purpose which is shell producing. The mantles are the shell producing organs of the oyster and also responsible for the manufacture of the nacre which is the mother-of-pearl like lining of the shell. This nacre is also manufactured in the mantle to combat damage done to the interior of the shell by parasites in order to protect the soft body of the oyster. It is this substance that forms the oyster pearl. Louisiand pearls are not of the gem producing type although as many as 60 or more have been found encased in one oyster.

In addition to its respiratory function in bringing oxygen from the gills to the tissues and in ridding the tissues of carbon dioxide by way of the gills, the blood serves in many other ways, two of which may be noted: it distributes the products of digestion to all parts of the oyster and brings unnecessary and useless chemicals (results of metabolism) to the renal bodies for disposal.

It is interesting to note that the blood of the oyster is chemically very closely related to sea-water. The concentration of salts in the blood changes as the sea-water around the oyster changes, yet the proportions of the salts remain the same and there is a constant ratio of sodium chloride to potassium chloride. The reason why this is mentioned is merely to point out one fact. As the late Dr. J. Nelson Gowanloch, Chief Biologist of the Bureau of Research and Statistics of the Department of Conservation once put it: "It is a fact, curious and not yet clearly explicable, that our own blood plasma in which our blood corpuscles float, not only contains the same salts as does sea water, but, further contains them in very closely the same proportions as does the sea." The blood of the oyster is really much like our own blood plasma—a "relative" of sea water, so to speak. Another explanation of the food value of oysters.

Suppose we go on and look into some of the chemicals found in oysters: Vitamin A, B, C, D, and G, phosphates and chlorides, necessary for healthy bones and teeth; magnesium salts, glycero-phosphoric compounds, carbohydrates, protein in large quantity and in easily digested form, all are found in oysters. Copper and iron, the metals so important for the prevention and treatment of almost all types of anemia, are present in sufficient quantities in oysters bred in Louisiana to make possible their recommendation as an "anti-anemic" food. Iodine, the element so widely known for its value in goiter prevention and treatment, is found in all oysters, and the Louisiana State Board of Health claims that Louisiana oysters showed greater iodine content than oysters from bedding grounds other than Louisiana! One average-sized Louisiana oyster a day, the Board of Health informs us, supplies five times the amount of iodine we must have for sound health.

From a culinary standpoint the oyster is a food, inviting, easily digested and high in nutritive value. A family of four may dine sumptuously off four dozen Louisiana oysters. Two dozen of these will make a delicious and nourishing *gumbo filé*—a creole dish unsurpassed in excellence and the remaining two dozen may be served in a variety of appetizing ways constituting an inviting and satisfying meal.

Very often just a dozen fine, fat, Louisiana oysters added to some left-over fricasseed chicken or tripe *ala Creole* will constitute a piquant dish sufficient to do ample service for another meal and at the same time the addition of the oysters lends the "left-over" a savory touch of novelty.

The juice of the oyster, which some do not use at all, is a valuable aid to the digestion. This fact was definitely proved by the experiments of Henri Chopin, a French scientist. Chopin maintains that the beneficial effects of the oyster before meals is due to the elements found in the juice. Certainly many oyster dishes are greatly improved by the addition of the finely flavored liquor, and it is well known that it can be used not only with safety but also with beneficial results.

Oysters produced from Louisiana reefs fall under three classifications: steam-canned, raw-shop and counter stock.

The steam canned oysters are dredged from the natural reefs of Louisiana. At the cannery they are opened by being subjected to steam. The meats are removed and placed in cans and processed. Many of the oysters for steam canning are provided for long in advance by shell planting which is carried on by the factories under the supervision of the Wild Life and Fisheries commission which requires that the factories bed specified numbers of barrels of shells. The young oysters attach themselves to these shells, and in about two years grow large enough to be brought to the factories. A great majority of the oysters canned in Louisiana and Mississippi come from Louisiana's reefs east of the mouth of the Mississippi.

Raw shop oysters require a great deal of cultivation. These are the oysters that are brought to the packing houses mostly by independent growers, removed from the shells and shipped in containers under constant refrigeration to all parts of the United States. These oysters are usually taken from he natural reefs, cleaned and separated and placed on bedding grounds leased from the state. Here they become better shaped and fatter. They are then taken up and brought to the packing houses, opened, packed in containers and shipped. There are as many as 12 to 15 operations in the handling of raw-shop oysters yet in all of these operations the oysters are never touched by human hand.

The counter stock are those of the highest grade, the most carefully cultivated oysters that are served on the half shell at the oyster counters in restaurants. These oysters, the pride of Louisiana and famed world over have hit, we hope, a temporary low in quality and size. We will get back to this later.

The oyster has many enemies however, the fact that the oyster has been here since the Jurassic and Tirassic geologic ages, long before man appeared on earth, may be an indication that it could remain with us for a long time to come.

In Louisiana, the Conch or drill or boring snail *(Thais floridana)* is one of the oyster's worst enemies. It attaches itself to the oyster and bores a neat hole through its shell and inserts its probiscus and extracts the meat. This deadly predator occurs over a wide area in Louisiana oyster bedding waters, however, it is an animal which must have a relatively high salinity water in which to live and it is this fact that has saved many an oyster bed from total ruin from the ravages of the conch. So serious are the inroads of these predators that extensive trapping of conchs is carried on by fishermen. In the spring, especially, when they are preparing to deposit their eggs the conchs demonstrate a marked tendency to climb upward. By taking advantage of this fact the oystermen trap the conchs by setting out stakes to which palmetto leaves have been attached and are driven into the bottom. The conchs climb these stakes in large numbers and lay their eggs upon them. The fishermen pass by at intervals and remove both the conchs and eggs and toss them up on the dry ground to die.

The saltwater drum also causes much damage on the bedding grounds by crushing the oysters and devouring the meat. These fish congregate in large schools and some of them weigh as much as 50 to 60 pounds. A bedding ground at the mercy of these voracious eaters may be destroyed in a single night.

The fishermen protect their bedding grounds by surrounding them with underwater fences of galvanized wire mesh strong enough to keep out the large fish.

Algae and other weeds often foul up the shells of oysters and boring clams and boring sponges also take their toll by drilling the oyster's shell, making it brittle.

Dermocystidium marinum, called D.marinum for short, a water borne parasitic oyster fungus organism, is another one of the oyster's enemies and has been demonstrated to be involved in the recent extreme summer mortalities of oysters. The presence of this fungus was first noted in the late 1940's, but examinations of museum specimens indicate that it was present in oysters as early as 1928. The disease seems to be exclusive in the oyster and is not transferable or harmful to humans. This parasite has been under the watchful eye and the subject of intensive study by biologists of the Oysters, Water Bottoms and Seafood division of the Louisiana Wild Life and Fisheries commission since its discovery. No satisfactory explanation has been given as to why this disease became epidemic in the early 1940's coincidental with industrial development on the coast although it has been demonstrated that the fungus was present in oysters since 1928 and before summer mortalities were evident.

In citing this coincidence James N. McConnell, Chief of the Oysters, Water Bottoms and Seafood division has this to say concerning claims made by private industries as to the oyster situation, "It is pointed out that oyster production in Louisiana has been more or less constant (between 650,000 bbls., since 1910) implying that the oyster industry is not declining, however it has not been pointed out that since the advent of heavy summer mortalities in the 1940's that the quality of production has dropped, more steam oysters are produced and fewer counter oysters are harvested and these are mainly of poor quality and the value of the production is considerably less than it should be."

"If we wish to admit that industrial activity may have had nothing to do with oyster mortalities and the epidemic increase of D.marinum and that the disease is also seen in other areas outside Louisiana in the East and on the Gulf Coast, it would still seem the most important aspect of the problem, namely, the factors causing this epidemic are far from clear. We do know this, however, that when we seek out new locations and recommend them to our oyster growers and the growers go ahead with their plantings these locations are eventually overtaken by industrial activity and the quality of oysters production decreases. Everyone asks, "Why are the counter oysters so inferior and so small? The answer is that the oyster bedder harvests his crop as fast as he can. The oyters are not allowed to grow large enough, the risk of loss is too great.

"In the days before the industrial development on our coast the fishermen bedded their oysters during the months of March, April and May. The oysters remained in the bedding grounds during the ensuing summer, the next fall and winter, and the next summer and were harvested during the second fall and winter.

"However, today, the fisherman beds his oysters in September, October and November and must harvest them before the end of the coming next June. If these oysters remain on the bedding grounds during the summer there will be a loss of from 75 to 90 percent or more. For this reason it can readily be seen that it is very difficult to obtain large cultivated oysters.

Typical desposition in our marsh areas which tends to dissrupt our natural flow of currents.

"It has also been held by scientists employed by industry that the effects of drilling mud on oysters conducted in tank experiments has proven that this mud has no detrimental effect upon the oysters. Such a result would be expected when inert clear mud is used as an experimental substrata for oysters. However, in actual practice such mud is often mixed with diesel oil, caustic soda, emulsifying compounds and possibly other chemicals. The question as to the effect of such mixtures upon oysters is not answered, yet we do know that, if nothing else, small amounts of such mud when mixed with oil causes an unpalatable taste in oysters and makes them unmarketable.

"The question of silting is brushed aside by comparing silt from industrial dredging to the normal Mississippi mire silt load, turbidity from squalls, and normal water silt. This comparison holds true but what is not taken into consideration is the diversion of currents by the mechanical change of the topography of the affected areas, the resultant change in current velocities and the inadvertent formation of settling basins by indescriminate placing of spoil banks with relationship to silting. It is obvious that silting will greatly increase from the dropping of normal silt loads if currents stop or are slowed down. The oyster man is all too well aware of this fact and selects a bed site well swept by currents in order to prevent silting.

"In many cases dredging and soil placement well away from the bed will so divert currents that the normal silt load in the water will settle and cover the bed. There are no two better examples of such drastic silting than Lake Grand Ecaille and Bay Long (Ronquille). Both of these bays have become so filled that a boat cannot operate out of marked channels.

"Attempts have been made to absolve geophysical activity of the guilt in oyster mortalities on the basis that experimental tests of blast effects fail to show any definite mortality trend. However consideration has not been taken of the effect on oysters on very soft bottoms, and damage that can be done and is done in shallow mud bottom bays by boats and marsh buggies used in seismic work and the carelessness of some seismic crews.

"Because of the many problems still confronting the oystermen of our state in their untiring efforts to continue producing oysters in areas where mineral activity is steadily increasing, it is to be hoped that both the mineral interests and the Wild Life and Fisheries commission will continue in their efforts to find ways and means whereby the oystermen may still produce oysters in quality and quantity as they did in 1936," McConnell says.

SEAFOOD SECTION

OYSTERS, WATER BOTTOMS AND SEAFOOD DIVISION

PERCY VIOSCA, JR.

Marine Biologist

The personnel of this section has given serious thought and study to the problems of the shrimp industry. During the past biennium, the research motor vessel "Albacore", a converted shrimp trawler, was put into service in connection with an expanded shrimp research program. The first cruise began on July 3, 1956 and was followed by many others. The "Albacore" investigations continue at frequent intervals.

We have concentrated our attention on the ecology, growth rates, and migrations of the commercial shrimp species, with special emphasis on the nursery grounds, or places where the young shrimp feed and make most of their growth. As opportunities developed, we studied the fishes and other organisms taken in the trawls along with the shrimp, as well as those taken in special nets and dredges.

As a result of these studies, we have made substantial contributions to the store of knowledge on shrimp biology. A summary of this knowledge was published in the July-August 1957 issue of the Louisiana Conservationist, 5,000 reprints of which were issued for general distribution under the title "The Louisiana Shrimp Story". A similar study, "Crabs", was summarized in the January 1958 issue of the same publication.

Other articles published by your biologist during the biennium are listed below:

1956. *Oyster Pests of Past Ages.* LOUISIANA CONSERVATIONIST, Vol. 8, No. 12, November. pp. 6-9.

1957. *Have You a Little Gecko in Your Home?* LOUISIANA CONSERVATIONIST. Vol. 9, No. 4, March. pp. 20.21. (The Turkish night lizard in New Orleans).

1957. *Rattlesnakes in New Orleans.* LOUISIANA CONSERVATIONIST. Vol. 9, No. 5, April. pp. 6-7.

1957. *Nature's Fourflushers.* LOUISIANA CONSERVATIONIST. Vol. 9, No. 6, May-June. pp. 10-11. (About curious reptiles and amphibians of Louisiana.)

1957. *Call the Police.* LOUISIANA CONSERVATIONIST. Vol. 9, No. 8, September. pp. 3-7. (About the greenhead fly and the policeman wasp.)

In view of the recent serious decline of the white shrimp (*Penaeus setiferus*) and the apparent invasion of their former forage grounds by another species, the brown grooved shrimp (*Penaeus aztecus*), it became urgent that we gather information which might throw light on the environmental changes which would have a bearing on this phenomenon. Both natural and man-made factors seem to play their parts, and these are likely interactive. The assembled data will be included in a paper entitled "What's Happening to the White Shrimp?".

As part of our comprehensive plan to study the influence of the Mississippi River upon the various shrimp stocks along our coast, information was gathered concerning the giant Delta shrimp, *Macrobrachium acanthurus.* This large river shrimp was found to be breeding successfully in the Delta of the Mississippi and in other slightly brackish water areas, and increasing quantities have reached the markets each year. Many scientific facts regarding this tasty shrimp and its invasion of Louisiana are being assembled for publication at an early date.

PERCY VIOSCA, JR.

Biological Sampling of Shrimp and Fish Populations

Population study blanks were prepared for recording the sizes of individual shrimp, crabs, commercial fishes, and a variety of food organisms, predators and competitors. One of these blanks with an actual record of a random shrimp sample is shown in *Figure 1.* The data from such blanks are plotted on charts, two sets being required for each species each year. One set of charts (*Figure 2*) shows the size range of a given species taken in the samplings, and the second set (*Figure 3*) shows the predominant size classes, or modes (M), from the same samples.

When the various charts are compared, it is seen that each species is characterized by its particular pattern, which the biologist can evaluate. These patterns yield much information on seasonal size distribution, abundance or paucity, growth rates, size and approximate age at which a species enters the fishery, and at which it enters and leaves the nursery grounds. Sex studies, when made, are plotted on a separate set of charts.

Stomach examinations are made of all important species taken in the nets, as time allows. These are yielding much information on the feeding habits of shrimp and their associates. As molluscs and other bottom organisms are frequently found in the stomachs of shrimp, crabs and bottom-feeding fishes, large collections of such organisms are gathered for study in special nets and dredges.

The Albacore is equipped with various electronic devices and other recording instruments. These are operated by Myles A. Patureau, who also serves in many ways as a biological aid. Mr. Patureau has recorded much hydrographic, climatological and other physical data which have a bearing on shrimp and fisheries biology.

The captain of the "Albacore," Phillip J. Trosclair, has been very cooperative, helping in many operations above and beyond the call of duty. The same may be said of our net maker, Louis Dupas, who is not only efficient at his assigned tasks, but lends a helping hand when necessary in the operation of the various nets and gear. Our deck hand, Joseph (Lucky) Calamusa cannot be overlooked, for he not only keeps the decks spick and span after many a muddy operation, but his pinch hitting in the gallery has kept us from missing many a needed hot meal after a hard day's work.

Summarized Results of Shrimp Studies

Growth Rates. The growth rate of juvenile white shrimp (*Penaeus setiferus*) on favorable inside nursery grounds during the warm months seems to vary around an order of magnitude of about 1¾ inches per month. Concurrent with this fast longitudinal growth, individual shrimp during a month on the nursery grounds, can multiply their weight by as much as five times. However, during the three coldest months, December through February, in inside waters, growth virtually ceases, to be resumed normally during the month of March.

White vs. Brown Shrimp

During recent years, there has been a noticeable increase in the catches of brown grooved shrimp and a corresponding reduction of the once common white species, formerly the mainstay of the shrimp industry. This reduction has been coincident with increasing salinities on the nursery grounds during the period extending from the summer of 1952 until the spring of 1957. Statistics on the annual river flow through the Mississippi-Atchafalaya System furnished by the Corps of Engineers, New Orleans District, show an average flow of water during 1952 followed by much lower than average flows from 1953 through 1956. This reflects a very serious five-year drouth in the Mississippi Drainage Area and a terrific shortage of fresh water reaching the shrimp nursery grounds.

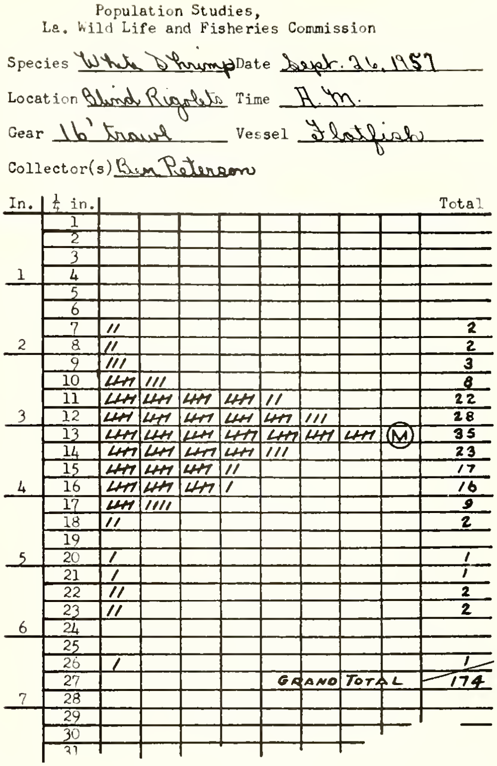
It seems evident from our studies that brown shrimp, especially larger specimens, are less tolerant of low salinities than the white species. There was always a progressive increase in size and numbers of brown shrimp with increasing salinities as the "Albacore" traveled from nearly fresh water through the brackish estuaries to the open sea. There is little wonder then that this species increased in numbers as salt water crept inward during the period of prolonged drouth.

Night vs. Daytime Trawling

Our studies show that the brown shrimp is not a schooling species, at least not to the extent of the white species. On calm days, especially in clear water, it is obvious that they bury in the bottom, and trawls pass over them. Night catches in clear water netted between 25 and 30 times as many brown shrimp as day time catches in the same places. However, in turbid water, such as found after storms or near dredging operations, or in the dark humus-stained water of streams draining extensive marsh lands, this was not the case, and there was relatively little difference between daytime and nighttime operations.

Effect of Dredging Operations

Whenever opportunities presented themselves, we studied the effects of dredging operations on shrimp and fish populations. Stomach examinations of fish taken near dredges showed that certain bottom organisms, such as mud crabs, were disturbed and made available to bottom feeding fishes. Anglers find fish concentrations near these added sources of food, and fleets of fishing boats congregate in such areas. Our studies have also shown that shrimp concentrate near dredging operations, much more so than on normal undisturbed lake bottom under otherwise similar circumstances.



Population Studies,
La. Wild Life and Fisheries Commission

Species White Shrimp Date Sept. 26, 1957
Location Blind Rigolets Time A.M.
Gear 16' trawl Vessel Flatfish
Collector(s) Ben Peterson

In.	¼ in.									Total
	1									
	2									
	3									
1	4									
	5									
	6									
	7	//								2
2	8	//								2
	9	///								3
	10	卌	///							8
	11	卌	卌	卌	卌	//				22
3	12	卌	卌	卌	卌	卌	///			28
	13	卌	卌	卌	卌	卌	卌	卌	Ⓜ	35
	14	卌	卌	卌	卌	///				23
	15	卌	卌	卌	//					17
4	16	卌	卌	卌	/					16
	17	卌	////							9
	18	//								2
	19									
5	20	/								1
	21	/								1
	22	//								2
	23	//								2
6	24									
	25									
	26	/								1
	27					GRAND	TOTAL			174
7	28									
	29									
	30									
	31									

Figure 1. Population Study Blank used for recording shrimp, crab and fish samples, with a record of an actual shrimp sample. "M", mode, or predominant size class. The size range from each such sample is transferred to one set of charts (Figure 2) and the modes to a second chart (Figure 3).

There is also another benefit from dredging operations. Buried organic muds contain important nutrients, such as phosphorus and nitrogen, which have been lost from the biological cycles. After screening out the sand or shell, the mud-laden fluid from the dredges returns to the upper lighted zone of the lakes where the plankton plant productivity is at its highest level. With a fresh supply of soluble nutrients, the activity of these drifting plants is stimulated, initiating a food chain in which shrimp play an important role. Trawling seems to have a similar beneficial effect.

Effect of "Flossie"

The hurricane "Flossie", striking in late September 1956, tore tremendous quantities of marsh grasses, peaty material and muck from the Louisiana Marsh in St. Bernard Parish. This was deposited in Lake Borgne and in Mississippi Sound as far east as Nine Mile Bayou. By the tenth of October, this material had begun to decompose, and a strong odor of hydrogen sulphide was evident throughout these areas, especially after nightfall.

Numerous dead clams (*Rangia cuneata*) and opened oysters with meat still attached, were taken in our dredges. About the only fish taken in the trawls in any numbers were hard-head catfish. In spite of their lack of crushing teeth, the stomachs of these fish were packed with clam meats. Normally hardhead catfish follow drums, sheepshead and croakers to pick up clam fragments accidentally rejected by these fish as they feed, but in this case, the meats were swallowed whole, indicating that they were sucked out of the shells as the clams died and opened up. The mortality of the *Rangia* clam in Lake Borgne seemed to be nearly complete, and this was verified by later studies. It is possible that the hurricane "Audrey", in June 1957, could have had a similar effect in the western part of the state.

Bottom Organism Studies

Because of the large amounts and numbers of bottom organisms found in the stomachs of shrimp, crabs and bottom feeding fishes, considerable attention was devoted to a study of this bottom life. During the month of May, 1957, Jay Weber, a noted malacologist from Miami, Florida, accompanied us on expeditions which extended from the lower courses of fresh water streams flowing into Lakes Maurepas and Pontchartrain, to the water of the open Gulf beyond the Chandeleur Islands. Since then, Mr. Weber has devoted considerable time to study and identification of the large numbers of molluscs collected, and we owe him thanks for checking those mentioned in this document. Mr. Weber's complete report and a named collection of Louisiana molluscs will be available to us within a short time. This will materially facilitate our ecological classification of the bottom types and enable us to better evaluate the nursery and spawning grounds of the various species of shrimp.

Stomach examinations of bottom feeding creatures seem to indicate that the *Rangia* clams are the most utilized bottom food organisms in the less saline brackish water lakes. These clams sometimes make up the bulk food item of such species as croakers, drums, sheepshead, hardhead sea catfish, fresh water blue catfish, crabs and shrimp. To our surprise they are a common foodstuff even of the striped mullet, *Mugil cephalus*.

Large drums feed on large clams, even up to their maximum length of about two inches. Small drums, large croakers, sheepshead, blue catfish and large crabs select smaller clams in the size range from ⅛ to ½ inch in longest dimension. Shrimp, small blue crabs, mud crabs and small croakers usually select clams under ⅛ inch. Mullets, while feeding in the mud, will pick up clams 1/16 inch and less.

Mullets, blue cats, and sometimes hardhead cats, swallow the clams whole, according to size. The mullets swallow mud and all, the catfish evidently reject the mud. Crabs, shrimp, croakers and drumfish crack or crush the clams and usually swallow shells and all. Sometimes crabs, after chipping away at the edges of clams, wedge one claw between the shells and pick out the meat with the other claw.

Large drums are in a class by themselves. There is evidence that they crush only the thinner, pointed ends of large clams with the crushing organs in their throats. Much of the meat along with small pieces of shell is then swallowed. The remaining large thick pieces of shell are rejected. In this peculiar process, no doubt many scraps of clam meat are lost, because mullets, hardhead catfish, other fishes, crabs and shrimp are attracted to the muddy spots where drums are feeding, and the stomachs of these are filled with bits of clam.

Also, due to the feeding habits of these large fish, broken shell accumulates on the bottoms of such lakes along with whole shells of clams which die of old age or other causes. These rejected bits of shell afford good cultch material for small mussels, sponges, hydroids, and barnacles, and provide hiding places for mud crabs, young blue crabs, and tiny snails, *Amnicola*.

Two species of mussels are found in the *Rangia* clam habitat. The larger *Modiolus recurvis*, is a ribbed species, which is more aboundant near the lake outlets where invasions of salt water are more frequent. The smaller, *Congeria leucophyta*, has a smooth shell and is generally more abundant in the less saline parts of the lakes. Both species attach themselves, singly or in clusters, to whole and fragmented clam shells, and often to the projecting tips of living *Rangias*.

These mussels and the tiny snails serve as supplemental food supplies for the bottom feeders and relieve some of the predatory pressure on the *Rangia* clams. The miniature snails are of an excellent size for shrimp and small crabs to crush and swallow whole.

Another common bottom organism in the brackish water

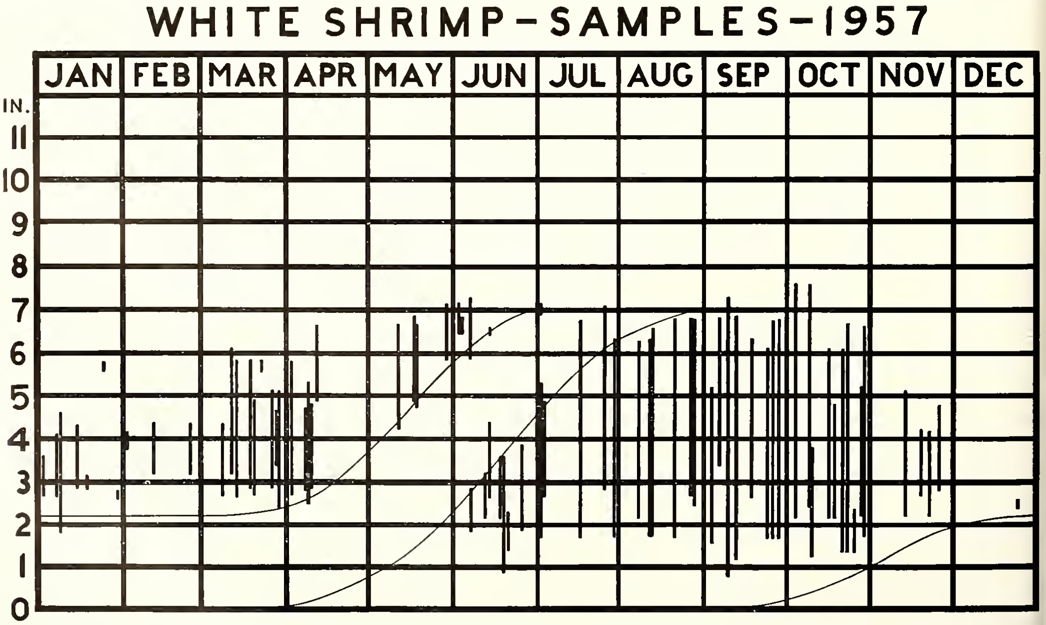


Figure 2. Size Range Charts are made each year for each important species and each large body of water. The presence (or absence) of a species in a given area during any season is seen at a glance. The curved lines show the minimum rate of growth of the spring crop of white shrimp and the maximum rate of growth of the summer crop.

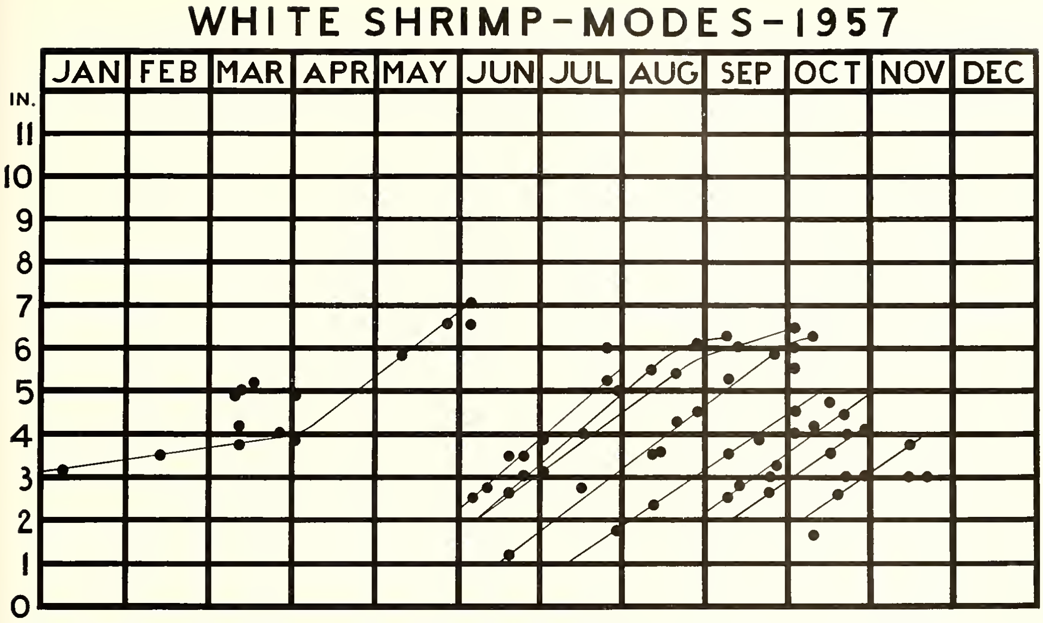


Figure 3. Mode Charts show the predominant size classes of different species in a given year. It is apparant that white shrimp come into the nursery grounds in waves rather than continuously. The diagonal lines are an interpretation of the rate of growth of the different waves of white shrimp in inside waters during the year 1957.

lakes is a small mud crab which can crack and eat small clams and snails. These and a variety of other bottom organisms play important roles in the food chains which develop on the nursery grounds frequented by our commercial shrimp species.

Shrimp abundance or scarcity depend, no doubt, upon conditions existing on such nursery grounds as were described in brief above. We are really just beginning to appreciate the nature and importance of these feeding areas. We must learn more about the effects of fresh and salt water invasions upon the lives of the innumerable bottom creatures upon which shrimp feed, of the competition for and between food organisms, and about the predatory creatures which seek out the shrimp themselves. Our set goals are far from achievement with the facilities and personnel at our disposal. Yet, we still continue to plan; and submit below, as part of this report, an outline of the more comprehensive research goal which we some day hope to attain.

Why Shrimp Research?

Shrimp crops are renewable aquatic resources which are being harvested largely by methods of spoliation. Restrictive measures as practiced in recent years have not resulted in increased catches per unit of effort or even in satisfactory sustained yields. Coincident with a constantly increasing pressure on this fishery, the cost of harvesting the diminishing supply has skyrocketed. In recent years, there has also been an alarming decrease in the take per man-day effort. Some restrictive legislation seems to be necessary, but all harmful and useless legislation must be replaced by a management of the fishery based on pertinent scientific facts. Such facts can be gained only by diligent and continued comprehensive scientific inquiry.

Status of Knowledge

Several investigations of the biology of shrimp, especially the white species, have been conducted during the past forty years. These have been discontinous, largely underfinanced, and not comprehensive enough to permit intelligent exploitation of the fishery.

A recent Fish and Wildlife Service questionnaire sent to biologists associated with the Gulf States Marine Fisheries Commission brought forth the following summary of the state of knowledge of the shrimp species of the Gulf of Mexico:

Knowledge Required	*Present State of Knowledge*
Identity of stocks	little
Growth rate	moderate
Natural mortality	fragmentary
Fishing mortality	fragmentary
Spawning habits	little
Number of eggs laid	little
Survival	fragmentary
Predators	fragmentary
Competitors	fragmentary
Environmental changes, natural	fragmentary
Environmental changes, man-made	fragmentary

Proposed Comprehensive Research Plan

I. *Physical characteristics of the shrimp enviroment and influence of atmospheric changes*

A. *Hydrographic data*
  1. sampling location
  2. depth
  3. currents: a. tidal, b. wind induced; c. river
  4. water condition: a. calm; b. choppy; c. high waves
  5. light pentration: a. Secchi disc; b. turbidity; c. color
  6. density
  7. water temperatures: a. top; b. bottom

B. *Meterological data*
  1. air temperatures: a. diurnal; b. seasonal
  2. wind: a. direction; b. intensity
  3. other atmospheric conditions: a. hours of sunshine; b. intensity of sunshine; c. precipitation

C. *Geological data*
  1. bottom type
  2. bottom condition: a. organic material; b. inorganic material

D. *Integration of physical data* (cause-effect relationships)

II. *Chemical characteristics of the shrimp environment and influence of land drainage*

A. *Water quality analyses*
   1. dissolved oxygen
   2. acidity: a. total; b. carbon dioxide
   3. hydrogen ion concentration (ph): a. as collected; b. after boiling
   4. oxidation-reduction potential (redox)
   5. alkalinity: a. total; b. carbonate; c. bicarbonate
   6. hardness: a. total; b. non-carbonate
   7. nitrogenous material: a. nitrate; b. nitrite; c. ammonia; d. organic
   8. phosphatic material: a. inorganic; b. organic

B. *Ionic analyses* (not included above)
   1. major metallic ions: a. calcium; b. magnesium; c. potassium; d. sodium; e. iron
   2. major non-metal ions: a. chloride; b. sulphate; c. sulphide; d. silicate
   3. trace elements (as required)

C. *Chemistry of the mud*
   1. carbon
   2. nitrogen
   3. phosphate
   4. sulphide and sulphate
   5. trace elements
   6. other

D. *Integration of the chemical data* (origin and destination of the nutrients)
   1. the carbon cycle
   2. the nitrogen cycle
   3. the phosphate cycle

III. *Biological characteristics of the shrimp species and their environments, and influence of associated species on shrimp populations.*

A. *The shrimp by species*
   1. sex life: a. dimorphism; b. reproductive mechanism; c. eggs and egglaying
   2. development: a. life in the sea; b. early movements; c. the post-larvae; d. growth phenomena; e. growth rates; f. overwintering; g. adolescence; h. seaward migrations

B. *Associated species* (population studies)
   1. plankton
   2. bottom organisms
   3. competitors
   4. predators
   5. parasites
   6. other

C. *Integration of the biological data*

IV. *Exploratory fishing and gear development studies*

A. *Sampling the catches*
   1. total catch (lbs.)
   2. shrimp catch breakdown
   3. edible fish catch breakdown
   4. trash fish catch breakdown
   5. other

B. *Evaluation of gear selectivity*
   1. catch per unit of effort: a. by gear; b. by depth; c. by area and bottom types; d. by time (day or night); e. by temperature and season
   2. ratio of catch retained to catch discarded
   3. evaluation of the byproduct fishery
   4. evaluation of the bait shrimp fishery
   5. evaluation of the sport trawl fishery

V. *Integration of the technical data.*

A. *Development of standards for evaluation*

B. *Classification of environments* (data to be presented graphically when possible)
   1. evaluation of normal environments
   2. evaluation of abnormal environments

C. *Overall integration of physical, chemical and biological knowledge*

VI. *Publication of results*

A. *Printed matter*
   1. news releases
   2. articles
   3. bulletins: a. technical; b. popular

B. *Audio and Video*
   1. radio
   2. movies
   3. lectures
   4. television

Recommendations to the Shrimp Fishery Relative to Changes in the Shrimp Statues.

1. *Definitions.* Salt water shrimp should be redefined to include all commercial species indigenous to our coastal waters by both their common and scientific names. It must be recognized, however, that the shrimp fishery is constantly changing, and additional species, now rare or beyond the range of the present fishery, may enter the catches. Therefore some phrase must be added to include any additional shrimp species.

2. *Size of Mesh.* More shrimp poundage per unit of effort should be realized by increasing the size of the mesh. Our studies show that in mixed schools of shrimp, the count is proportional to the size of the mesh, a much higher percentage of small shrimp escaping with each step up in the size of the mesh. As shrimp on favorable nursery grounds during the warmer months appear to double their weight about every 12½ days (multiply 5 times per month), these escapees will be available to the fishery at enhanced values in a short time. I realize the heavy investment in ¾ in. mesh trawls and do not think it fair to make a sudden change-over. Perhaps a change in the law should take about two years to become effective. Meanwhile our studies of selectivity of the different mesh sizes should be enlarged and also augmented to include the experimental use of cod ends with rigid framework designed to prevent the drawing together of the meshes.

Closed Seasons, Inside Waters. I recommend closure of "inside waters", or nursery grounds, during the months of December, January, February, March, April, July and August. The remaining five months, May, June, September, October and November, shall be construed as open seasons. With night trawling permitted, these five months would be equivalent to ten months of the present season.

My recommendation for December closure is based on the observation that all large shrimp of the summer crop will have left such waters before the end of November. The last heavy seaward migration of large white shrimp usually begins around the first of November, leaving only small shrimp in inside waters. Nursery ground trawling in winter can destroy the cream of the spring shrimp crop.

I recommend closing July because relatively few large brown shrimp remain in inside waters during that month, and a large proportion of these can be caught after they return to the open sea. The Gulf has many calm periods in July, it is usually favorable for trawling brownies at night, and I believe the industry will be greatly benefited by protecting the white shrimp nursery grounds during that month. Inside trawling in July will break up the school of very small shrimp, and schooling is one of their defense mechanisms against predators.

Live bait dealers and their legitimate employees should be provided with a special license to take live bait shrimp in inside waters during closed seasons.

Closed Season, Outside Waters. Considering the high reproductive potential and rapid rate of growth of marine shrimp, it has been the general belief among biologists that the extent and condition of the nursery grounds are by far the major determining factors of shrimp production, rather than the numbers of eggs spawned or larvae developed. However, at the October 10-11, 1956 meeting of the Gulf States

Marine Fisheries Commission, I ventured the suggestion that the white shrimp breeding stocks, whatever the cause, may have reached such a low level that the demands of natural enemies which prey on eggs and larvae could not be satisfied. Under such conditions, it may be possible that the numbers of larval shrimp coming into the nursery grounds have been reduced far below the quantities required for restocking those areas to their carrying capacity.

If it is thought advisable to experiment with a closed season in outside waters, it would of course be necessary to make a compact with other Gulf States in which suitable spawning grounds for white shrimp exist. Even then, I would not recommend a closed season beyond the framework of days included in the months of May and June. In those months, the bulk of the larvae are spawned from which are produced the peak of the summer crop, the real money crop in inside waters. Furthermore, in those months, the shrimp fishery would not be curtailed too severely. Many of these adult shrimp could be caught later, after spawning, and besides, during that period, there would be an open season in inside waters, for this is when the spring crops of white and brown shrimp are being harvested there.

4. *Limitations on Bait Trawls.* My recommendation is to limit the so-called bait or sport trawl to a length of ten feet as measured along the longest line between the boards, and to enforce the same mesh limitations and seasons as required for commercial trawls. The bait seine should be limited to 30 feet without mesh limitations. During closed seasons, licensed anglers on the fishing grounds should be permitted to have in possession not exceeding five pounds of dead whole or headless shrimp and 150 live shrimp per person for use as bait.

5. *Night Trawling.* I am in favor of elimination of the ban against night trawling because night catches consist largely of brown shrimp, and the practice relieves some of the pressure on the more heavily exploited white species. Although there are some disadvantages to night trawling, shrimp taken at night during the hot summer months can be brought to icing docks and boats before being exposed to the sun's heat, thereby assuring a better product.

6. *Chumming of Shrimp.* Every fisherman is in technical violation of the ban against chumming, because, until all trash fish is marketed, such trash must be thrown overboard and the decks washed down in the interest of sanitation, and to make room for the next drag.

7. *Experimental Gear.* I strongly urge that the Commission be granted authority to issue permits for experimental testing of new methods, gear, etc. in waters in which it is legal to take shrimp, provided the permit holders keep records for our use in evaluating the experimental operations, and our biologists be permitted to study the devices while in use.

8. *Definition, Inside Waters.* I favor a definition of "Inside Waters" to include the nursery grounds which extend some distance into the Gulf. I believe that the three fathom contour line (18 foot depth) would effectively delimit the "outside" nursery grounds which extend around the mouths of rivers and passes and along the Gulf shores. I am opposed to an imaginary line because of the difficulty of enforcement.

9. *Commercial Fishing Licenses.* There are two ways to solve this problem. One is to license all boats operating fishing gear at so much per vessel. The other is to license commercial fishermen at so much per head. The latter is a better conservation measure because it permits a fisherman to shift his efforts from a species which is scarce or out of season to others which are plentiful or in season, without the gamble and expense entailed in purchasing an additional license. It encourages exploratory fishing rather than hinders it and permits changes of plans according to market conditions, weather, or other unforseen circumstances.

All trawls over 10 feet and seines over 30 feet should prima-facie be considered commercial. Any person selling his catch, no matter how taken, should automatically become a commercial fisherman.

If a universal commercial fishing license is adopted, business firms which have a turnover of employees, no matter on what basis employed, or boat captains, may secure enough licenses for their crews in the company name, these licenses to be kept in full view on the boat from which the gear is operated. A properly licensed commercial fisherman may fish for legalized species with any recognized legal tackle without the payment of additional license fees.

Without licensing, it is impossible to keep tab on the catch per unit of effort which is so important to properly evaluate the condition of any fishery.

10. *Confiscation of Tackle.* Where confiscation of tackle is mandatory, distinction must be made between tackle which is prima-facie illegal, and legal tackle which is being illegally employed. The latter should be returned to the violator after he has paid his fine or served his sentence.

11. *Imports of Shrimp.* Imported shrimp may be legally processed in Louisiana regardless of count, provided evidence of purchase can be shown. However, there must be safeguards against landings in Louisiana of illegal shrimp taken on the high seas.

Assessment of Results of Regulations

In recommending the above changes in the shrimp statutes, one final point should be considered. The factors controlling the abundance or scarcity of shrimp are complex and not fully understood. No guarantee can be given that benefits obtainable from new regulations will outweight the losses of harvest occasioned by them. It is a situation of trial-and-error, requiring the best possible judgement of what is needed and a careful assessment of results.

However, precise assessment of the effects of new regulations will be difficult. This is because conditions for development of shrimp crops and subsequent harvests are influenced by many factors, some natural, some man-made, which in turn show trends which change from time to time. The net effect of these variables during the next decade might be quite different from those of the past. Even after long-continued experimentation in many states with regulations intended to improve the shrimp harvests, it is still uncertain what the effects of these efforts have been.

The difficulty in designing and evaluating fishery regulations is recognized by modern fishery science, but a method of overcoming this difficulty has been devised (see Burkenroad: "Theory and Practice of Marine Fishery Management", Jour. Cons. Int. Expl. Mer, 1952). The method is to apply regulations discontinuously; for example, to close waters to seasonal fishing in alternate years instead of every year. In time, the average results during the years when the regulations are applied can be compared with those in adjacent years when the regulations were not in effect. The influence of trends of change in man-made and natural factors can thus be cancelled out, and the actual effects of the regulations can be distinguished from those of coincidental changes of other kinds.

The *controlled* type of marine fishery regulations described above, which recognize the situation as one of trial-and-error and provide for proper evaluation of results, would place Louisiana in the forefront of modern developments in marine fishery management. Whether or not the expected benefits accrue, a foundation of knowledge would be laid for future progressive improvement.

THE LOUISIANA SHRIMP STORY

To most of us a shrimp is just a shrimp; to be dunked in sauce or enjoyed in gumbo or jambalaya and in the many ways our gourmets have developed for preparing them over the years. However, there's really a big story behind this crustacean that Louisiana gives to world markets in such abundance.

Many kinds of shrimp find conditions favorable for their existence in Louisiana waters and the nearby Gulf of Mexico. Their habitats are varied and sometimes extensive, and the actual populations of the different species and their relative abundance result from the interaction of many factors, among them: the physical and chemical qualities of the water, the nature of the bottoms, the kinds of vegetation or the lack thereof, the effects of competition and predation, and the availability of foodstuffs. Some species exist in unbelievable abundance, and the larger kinds support a vast industry.

From early colonial times, two shrimp species were plentiful on the New Orleans markets; and no doubt the common names of these, "river shrimp" and "lake shrimp", originated in that city. The term "lake shrimp" referred to the most plentiful of our migratory salt water species, the young of which appeared in Lake Pontchartrain every summer, sometimes in great schools.

Baited traps were employed for snaring river shrimp, and cast nets and seines for taking lake shrimp. No doubt we learned our trapping methods from the Indians, but the nets first employed in Lake Pontchartrain were brought over from France (Du Pratz, History of Louisiana). To this very day, and now more so than ever, one of the favorite pastimes of New Orleans people on summer nights is to go cast-netting for shrimp along the seawall which skirts the north side of the city. On favorable nights, shrimpers number in hundreds and spectators in thousands.

Early in the century, biologists, who were then few and far between, recognized additional shrimp species as being present in our waters. These either went unobserved by the consuming public, or were considered merely as curios or rare specimens. Seiners, however, who ventured outside, along the Grand Isle beaches or near the mouth of Bayou Lafourche, long recognized a small sea shrimp which they called by various names, such as "sept barbe" and "seabob" Large catches were sometimes made by seining the beaches during favorable weather, but ice was a scarcity during these sailboat days, and inland consumers knew not of their existence. The bulk of the seabob catch was dehydrated on sundrying platforms which dotted the coastal bayous and shipped to Chinese colonies the world over.

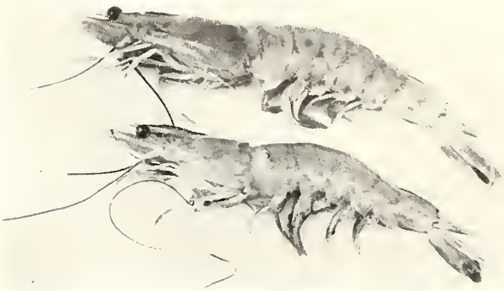
Ice boats came after the turn of the century and gave a boost to a struggling canning industry. Also, about this time, gasoline engines slowly came into use. The otter trawl was first tried in 1915 and its use increased rapidly. With the advent of power boats and the development of sea going trawlers, the shrimping grounds were greatly extended, and both drying and canning industries grew by leaps and bounds. The number of trawlers passed the thousand mark in 1923 and usually exceeded the three thousand mark after 1940. Today many of these boats are of the super deep sea type and forage entirely in the open Gulf.

There must be an answer for such development and of course there is a logical one. Nowadays, due to the development of refrigeration, new methods of harvesting, canning, packing, new preserving techniques and rapid transportation, Louisiana shrimp are reaching world wide markets never before dreamed of. This subsequent demand is calling upon the ingenuity of gear developers, exploratory fishing and technological researchers. The latter are under the supervision of the Wild Life and Fisheries commission which works toward this end in cooperation with other governmental agencies.

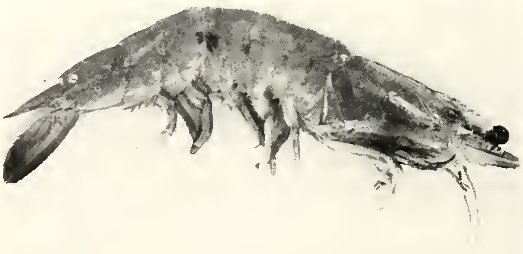
It was not so many years ago that a shrimp course was practically unknown to the tables of the average American home. Aside from the menus of the famous gastronomical emporiums of the nation the Louisiana shrimp was strictly for the table of our native population. Today the Louisiana shrimp is known to the tables of our entire nation and abroad. At the New Hilton hotel in Istanbul, for an instance, Louisiana shrimp are a daily feature of its menu and served as casually and in as much profusion as though they had been seined that morning from the waters of the Bosporus.

Today shrimping is no longer a matter of going out in a small boat and bringing back a pay load. Trawler hull designs have been changed and gear has been developed to handle shrimp faster and with more facility. Navigation aids, such as radar, fish finders, ship-to-shore radio, fathometers and other gear are now in reach of not only the big operators but also the small independents. Now the small boats may also venture far from shore with comparative safety and are no longer relegated to their immediate home waters and the use of shoreline landmarks. Electronic devices have become as familiar as the compass to these men whose fathers and grandfathers shrimped with sail power.

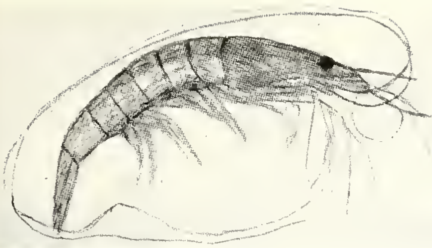
As the trawlers ventured into new fishing grounds, additional species entered commercial channels. One fairly abundant kind differed from the common lake shrimp in that the head and tail regions were adorned with grooves, whereas in the lake shrimp there are no grooves. Confused with another grooved shrimp, this species became known as the "Brazilian shrimp." Today we recognize two grooved species here,



The White Shrimp *(Penaeus setiferus)*. For many years our most important species and mainstay of the shrimp industry of the northern Gulf of Mexico. Above, adult female which averages somewhat larger than male, below. One third natural size.



The Pink Shrimp *(Penaeus duorarum)*. Relatively rare along the Louisiana coast, numbers harvested increasing since advent of night trawling. On this female note dark spot at junction of third and fourth tail segments. One third natural size.



The Seabob *(Xiphopeneus kroyeri)*. A long name for a short shrimp which seldom grows over four inches. Is still an important species in the dried shrimp industry and is sold on other markets when large shrimp are scarce. Natural size.

better known as brown and pink shrimp, but neither is the true Brazilian shrimp, which has not been taken in the Gulf of Mexico. The whitish "lake shrimp" of olden times has now become known as the "white shrimp" to better distinguish it from the more colored species.

The brown and pink shrimp resemble each other in many respects, but have very good distinguishing characteristics, and their habitat preferences differ materially. On the other hand, immature brown and white shrimp occupy much the same nursery grounds, and although their spawning seasons and ranges differ somewhat, there is considerable overlap. The brown and white species, therefore, can be considered competitive. The pink shrimp, on the other hand, is relatively rare in Louisiana, largely for lack of suitable habitat, and it does not compete seriously with the other species. Where the habitat is favorable, as on the fabulous shrimping grounds discovered near Dry Tortugas and Campeche in recent years, the pink species is found almost to the exclusion of the others.

During the past several years, catches of the two native grooved shrimp, the browns and the pinks, have increased considerably. This is partly the result of night trawling and partly due to an extension of the fishing grounds with increased knowledge of their habits. Part of the increase may also be due to the higher salinities on the nursery grounds as a result of the prolonged drouth in the mid-continental area and lack of fresh water from the Mississippi River. This is believed to be a factor favoring the two grooved species to the detriment of our more familiar white lake shrimp.

There are also found in the northern Gulf, thanks to the operations of the U. S. Fish and Wildlife Service vessel "Oregon", some exquisite-tasting, deepwater shrimp, all red in color; and it seems that commercial possibilities for these exist. Less shrimp-like in form are the so-called "rock shrimp". The writer rates both the red and rock shrimp as food for gourmets, but we must await their arrival on the market place.

Another newcomer in the commercial field but of a different nature, is a giant, non-migratory, brackish water shrimp which has established itself in the Delta of the Mississippi river. This is closely related to our common river shrimp, and seems to be replacing that species in the smaller passes of the river and in the small bays which lie between the fingers of the Delta.

Then there are a number of kinds of smaller shrimp, both in fresh and salt water. These are important in the economy of our waters and serve to relieve some of the predatory pressure on our commercial species. Several kinds are used for bait and are sold by bait dealers for fresh or salt water fishing, as the case may be.

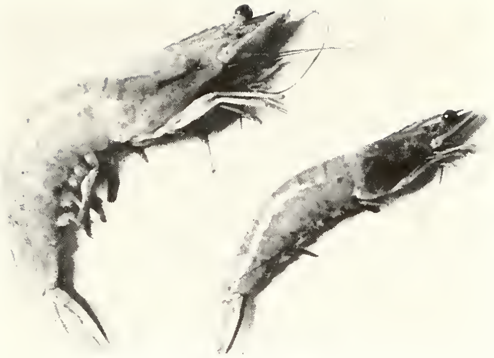
If you are interested in learning more about the shrimp you eat or use to bait your hook, remember that color may be a poor criterion for distinguishing species. Shrimp all possess the chameleon-like power of changing color to match their surroundings. Fortunately there are other characters which enable us to tell them apart, and the shrimp fishermen and bait dealers are rapidly learning to identify the different kinds.

The Free-Spawning Shrimp

The sea-shrimp we utilize for food are misunderstood by laymen who never see their eggs or babies, as they do with most other familiar creatures, such as crawfish, birds, alligators, etc. This is in part because of the remarkable migrations of these sea shrimp, on a par with those of the salmon and the common eel, and in part because of the complicated transformations their very young under go before they even look like shrimp. Anybody can recognize a baby crawfish, but a baby shrimp, that's a different story.

Our edible sea shrimp deposit their eggs freely in the waters of the Gulf, and there is no parental protection. They are at the mercy of the ocean currents and whatever adversities these may bring. Such free-spawning creatures must of necessity produce much greater quantities of eggs, by at

Development of refrigeration, new methods of harvesting, canning, packing and preserving techniques assure this shrimp fisherman of markets never before dreamed of by his forefathers.



The Brown Shrimp *(Penaeus aztecus)* is now becoming increasingly important in the northern Gulf. Above, adult female, ranges from seven to nine inches or more. Male, below, averages a little over six inches. One third natural size.

least a thousand-fold, than related species which protect their eggs to some extent.

The eggs of free-spawning shrimp hatch into very simple larvae, mite-like in appearance. These undergo a number of transformations, each more shrimp-like than the preceding, but all early stages are carried about at the mercy of the currents. Only advanced larvae which are fortunate enough to be carried onto favorable nursery grounds will survive the hazards of early life and transform into little shrimp such as those we find later in the lakes.

Once in inside waters or on other suitable nursery grounds, the young shrimp grow rapidly. Upon nearing adolescence, those on the inside return to the sea from whence they came. Here they make their final transformation into full-blown adults, which in the larger species, we call "jumbo" shrimp. Those most important in the current fishery are discussed separately below.

The White Shrimp *(Penaeus setiferus)*

Common Names:—for young: white shrimp, lake shrimp, white lake shrimp, creole shrimp, season shrimp, spring shrimp (in spring only); for adults: jumbo white shrimp, Gulf prawns.

For many years the white shrimp has been our most important species and the mainstay of the shrimp industry of the northern Gulf of Mexico. Before the adults (prawns, jumbos) were generally recognized as the same species, young white shrimp were sold under the common name "lake shrimp" to distinguish them from the smaller "river shrimp".

The first young white shrimp born in any given year make their appearance along our shores by early June, and are mostly less than an inch long. These migrate away from the sea as summer advances, growing rapidly and attaining lengths up to six inches and more by the end of August. Upon reaching sizes averaging around six inches, they begin to move back to the sea from whence they came, never to return to inside waters.

In any given year, the last young recruits from outside waters enter the nursery grounds in the early fall, but growth of these is retarded by cold weather. These resume growth the following spring, hence this crop of young white shrimp is called the "spring shrimp". Virtually all of these grow up and return to the sea before the summer solstice. Because of the regular seasonal appearance of great schools of white shrimp in coastal lakes, they are sometimes known as "season shrimp".

In the sea, adolescent white shrimp transform into adults, whose lengths normally range from about seven to nine inches or more. The females average somewhat larger than the males, say about nine to the pound as against ten to the pound for the large males. Occasionally the females approach a length of ten inches and may weigh up to three ounces or more. The adult white shrimp forage on the sea bottom, somewhat like cattle on a ranch, but seldom go out to bottoms covered by more than 100 feet of water.

The Brown Shrimp *(Penaeus aztecus)*

Common Names: — for young: brown shrimp, brow grooved shrimp, brownies, green lake shrimp, night shrimp, Brazilian shrimp (misnomer); for adults: jumbo brownies, orange or golden shrimp, golden night shrimp, jumbo grooved shrimp.

Brown shrimp are becoming increasingly important in the fishery of the northern gulf, especially since the deep sea trawlers have extended their trawling grounds beyond the range of the white species and have learned to fish at night. What happens to the shrimp during daylight hours can only be surmised. From various bits of evidence, the writer believes they bury in the bottom, perhaps deeper and to a greater extent than do the white shrimp.

Brown shrimp do not seem to gather in schools as huge as those of the white species, and scattered populations are present on the nursery grounds and in the open sea at all seasons of the year. Their life history in a general way is similar to that of the whites, although they seem to spawn earlier and over a longer period. When conditions are otherwise favorable, this gives them a biological advantage over the white species.

The first brownies born early in any given year grow rapidly in the spring. Large movements back to the sea take place during June and July. Such migrating brownies are usually between 4½ and 5½ inches, as compared to 5½ to seven inches for the returning white shrimp. Relatively few brownies as large as six inches are taken in inside waters.

Growth of male brownies ceases at a much smaller size than for male white shrimp, and they do not attain true jumbo size. Female brownies, on the other hand, continue to grow until they are at least as large or even larger than the females of the white species. Large male brown shrimp average a little over six inches, and the maximum is around seven and a half, and the average weight is about 20 to the pound. Females, however, range from about seven to nine inches or more and average perhaps about ten to the pound. Much larger females have been reported, the maximum approaching 10 inches and weighing some four ounces or more. Adult brown shrimp range seaward in much deeper water than the white species, to at least 300 feet.

The Pink Shrimp *(Penaeus duorarum)*

Common Names: — for young: spotted shrimp, skippers (in the bait trade), hoppers (to commercial trawl fishermen); for adults: pink shrimp, pink grooved shrimp, pink night shrimp, spot shrimp, jumbo hoppers.

Pink shrimp are relatively rare along the Louisiana coast, although the number harvested has increased considerably in recent years, especially since the advent of night trawling. The young of this shrimp prefers relatively clear shallow water, and its best nursery grounds are in quiet waters with firm bottoms upon which there is a protective growth of some kind. This may be vegetation such as turtle grass or algae, or animal growths such as sponges, bryozoons and corals. The Chandeleur chain of islands affords the only relatively large area of this kind in Louisiana that is not muddied periodically by flows from mud-laden rivers. Consequently it is our best pink shrimp nursery ground. During daylight hours, pink shrimp seem to bury in the bottom or hide in the shade of vegetation, sponges, etc., coming out only at night to feed.

The life history of the pink shrimp is perhaps similar to that of the preceding two species. The adults, although preferring a somewhat different type of bottom, range in depths intermediate between the outer extremes for the whites and browns respectively, or about 100 to 200 feet. Like the browns, the pinks seem to be present on suitable nursery grounds at all seasons of the year. In the Gulf, off the Chandeleur islands, although generally too scattered to support a separate fishery, fair numbers are taken incidental to fishing for other species, or as a by-product of the so-called "trash fishery" for catfood and other products. They constitute, therefore, an added dividend.

As with brown shrimp, male pink shrimp average smaller then the females. They are rarely over six inches and weigh around 24 to the pound, whereas females are usually 6½ to 8½ inches and may average 10 to 13 to the pound. Some few females will grow as large as the superjumbo browns and whites.

Pink shrimp are little wider than the other jumbo species of the same lengths and are able to crawl on the deck of a boat like river shrimp and hop upward, hence are known as "skippers" or "hoppers".

The Seabob *(Xiphopeneus kroyeri)*

Common Names: — seabob: six beards, seven beards, all corruptions of the French "six barbe" and "sept barbe". Counting the elongated head spine, there are really eleven slender forward extensions, some more conspicuous than the others.

The seabob is a small shrimp, adults of which are seldom over four inches. It is still an important species in the dried shrimp industry and sometimes is sold on other markets when larger shrimp are scarce. In other states it may enter the highly saline waters of coastal bays, but in Louisiana, where the waters are muddied and freshened by large rivers, it is confined almost entirely to the open Gulf. Here, large schools sometimes swarm along the outer beaches.

The Egg-Bearing Shrimp

The egg-bearing shrimp belong to a different family from the free-spawning sea shrimp mentioned above. As with the crawfish, the female deposits her eggs in an elongated pocket under her abdomen and they are held there until a few days after they hatch. The newly hatched young will even leave and return to the protection of the mother for a time.

Thus the females protect their eggs and young during what would otherwise be the most hazardous period in the life cycle, and a much smaller number of eggs is required to maintain such species than with the free-spawning sea shrimp.

In addition to the edible species, and this refers to size only, there are several smaller species of egg-bearing, so-called grass shrimp, which, in the aggregate, cover the entire salinity range from fresh to sea water. Some are sold for bait, especially in the fresh water areas.

The River Shrimp *(Macrobrachium ohione)*

Common Names: river shrimp, common river shrimp, stump shrimp.

This is the species which has always been considered a great delicacy and a food for gourmets of Old New Orleans. Unfortunately it is so small that the larger sea shrimps are gradually pushing it off the markets. Table size adults average about 100 to the pound.

The river shrimp, alias stump shrimp, is a favorite in the bait industry as it lives long in captivity. The body is stout and cylindrical as compared to the marine shrimp, and captured specimens will crawl like crawfish rather than lie on the side.

Dark portion shows ovaries of the mature female White Shrimp containing about ¾ million eggs. Fifty such shrimp could re-stock Lake Pontchartrain with 10 pounds of shrimp per acre if all eggs and offspring survive the hazards of early life.

The river shrimp inhabits the larger rivers of Louisiana from the Pearl to the Sabine, but is commercialized largely from the Mississippi and the Atchafalaya. It also inhabits fresh water lakes in the flood plains down to the very edge of salt water. It is taken largely by means of baited traps, using either meal or animal matter for bait. Another method, especially applicable in the lakes, is to suspend willow or wax myrtle branches in the water. A net is slipped under the branches as they are periodically lifted to the surface.

The Delta Shrimp *(Macrobrachium acanthurus)*

Common Names: Delta shrimp, giant river shrimp, long-clawed shrimp.

This is another newcomer in the commercial field. For the past decade it has been found in increasing numbers each succeeding year. It has not only established itself in the delta of the Mississippi river, but also in some of the slightly brackish water of coastal lakes and bayous. Although it seems to be replacing the common river shrimp in the Delta in the vicinity of the passes, which permit periodic influx of salt water, it has not ascended the Mississippi above the passes in commercial quantities.

Like the common river shrimp, the newcomer is taken best by means of baited traps, but a larger entrance cone is necessary than for the smaller species. The long unwieldy claws of the adult males places this species in a class by itself among Louisiana shrimp. Select male specimens average 16 to the pound, females about 30, but what is more important, these delta delicacies are a delectable dish.

How to Distinguish the Edible Shrimp

The *length* is the total length measured from the tip of the spine, or blades, whichever is the longer, to the tip of the tail fan.

The *head* is the first large segment containing the head and thorax parts (Latin designation, *cephalothorax*).

The *tail* comprises the rear six fleshy segments of the body, or *abdomen*.

The *spine* is the pointed forward projection of the head (Latin, *rostrum*).

The *blades* are a pair of oar-like projections on the head below the eyes (Latin, *scaphocerites*).

The *whiskers* commonly referred to as such are the main or second pair of whiskers, a pair of hair-like organs attached to the base of the blades (second antennae).

The *short whiskers* are really the first whiskers, a branched pair of hair-like organs attached above the blades (first an-

GROUP A. FREE-SPAWNING MARINE SHRIMP

Segments higher than wide. First three pairs of legs with pincers. Females without egg-pocket. Migratory or wandering marine species, the young of which may enter brackish waters.

THE WHITE SHRIMP, *Penaeus setiferus*. Ridge on top of head not bordered by grooves. Three hind tail segments with keels. Keel on last segment not bordered by grooves. Spine slightly longer than blades in young, slightly shorter in adults. Main whiskers about twice the length of the shrimp. First whiskers short.

THE BROWN SHRIMP, *Penaeus aztecus*. Keel on top of head bordered by grooves which converge slightly towards the rear. Spine shorter than blades. Three hind segments with keels, the last bordered by grooves which are wide and deep enough to receive the edge of your fingernail (except in very small shrimp). Main whiskers close to 1½ times the length of the shrimp. First whiskers very short.

THE PINK SHRIMP, *Penaeus duorarum*. Keel on top of head bordered by wide parallel grooves. Spine shorter than the blade. Two hind segments with keels, the last bordered by shallow grooves, not deep enough to received the edge of your fingernail. The third to last segment with a rounded ridge, not a true keel. The main whiskers not quite 1¼ times the length of the shrimp. First whiskers extremely short, mere rudiments. A blackish or reddish spot, usually very conspicuous, adorns the tail at the junction of the third and fourth segments.

THE SEABOB, *Xiphopeneus kroyeri*. Ridge on top of head segment not bordered by grooves. Spine very long, distance from eyes to tip about twice as long as distance from eyes to tip of blades, strongly curved upward in front of eyes. Main whiskers about three times the length of the shrimp. First whiskers also very long. The last two pairs of legs also extend forward as whisker-like filaments. The common names are derived from these structures which give the creature a bearded appearance. A small shrimp seldom reaching four inches in length.

GROUP B. THE EGG-BEARING SHRIMP

Segments more or less cylindrical. First two pairs of legs with pincers. Females with egg-pocket. Non-migratory, fresh or brackish water species.

THE RIVER SHRIMP, *Macrobrachium obione*. Spine of moderate length, not exceeding the blades, somewhat leaf-like and serrated except for the upturned tip which resembles a stylus, about 11 serrations on the upper edge and usually three on the lower. Second pair of legs long and slender, but less than the length of the shrimp. Main whiskers less than 1½ times, first whiskers about equal to the length of the shrimp. A small species seldom over three inches long.

THE GIANT DELTA SHRIMP, *Macrobrachium acanthurus*. Spine long, exceeding the length of the blades, lance-like and usually curved upward; about 9 serrations along the upper edge and about 6 along the lower, serrations extending almost to the tip. In mature males, the second legs are longer than the shrimp, in females and young, less than the length of the shrimp. Main whiskers over 1½ times, first whiskers about as long as the shrimp. A fairly large species, males of which may reach six inches, females 4½.

THE GRASS SHRIMP. Several species of so-called grass shrimp inhabit Louisiana waters. All are egg-bearing and the largest are seldom over two inches long. They are usually found in grass or weed beds or vegetation of some kind. Their habitats vary from fresh water ponds and lakes to the open sea. The little brown shrimp found in floating beds of seaweed (sargasso sea) belong to this group. Grass shrimp are often mistaken for the young of other species but, as stated above, seldom grow over two inches long.

COASTAL WASTE CONTROL

Jack Hood

Supervisor

Enforcement of the Coastal Waste Control program has been designated to the Division of Oysters, Water Bottoms and Seafood by the Stream Control commission and operations are in charge of Jack Hood. They include patrol of oil field installations and drilling operations on the coastal area from southwest of Houma to the Mississippi state line.

To this end, a 36-foot patrol boat, equipped with radio communication apparatus linked to the commission's headquarters towers, is operated on a year-round basis enforcing the commission's regulations in coastal streams.

Primary efforts of the patrol are to work with and patrol mineral developers on our coastal streams to prevent pollution of waters and marshes caused by oil field wastes which result from mineral operations and explorations. This pollution is caused by the purposeful or accidental discharge of various harmful wastes which produce a detrimental effect upon fish, oysters and water bottoms.

The object of this patrol is to educate operators as to the necessity for the proper disposition of crude oil, waste oil, sludge and oil and chemical bearing mixtures and to make checks against carelessness, negligence and violations and make necessary arrests in case of violations. These rules govern disposal of waste, oil, field brine and other materials resulting from the drilling for, production of, or transportation of oil, gas or sulphur, and also include the inspection of disposal devices, pipeline valve leaks, barges used for crude oil transportation, loading racks, barge loading outlets and similar operations where precautions should be taken against spillage.

So far, Hood reports general cooperation and a yearly average of ten arrests for flagrant violations. Most of the violations are the result of carelessness and a constant patrol is necessary in order to control certain offenders who are in a minority.

ENFORCEMENT DIVISION

RUDOLPH P. EASTERLY

Chief

RUDOLPH P. EASTERLY

During the past two years the Law Enforcement division has been under the successive direction of two men whose wealth of enforcement background has been reflected in the remarkable record for efficiency and esprit de corps set by the division.

Rudolph P. Easterly who, in 1957, succeeded Louis F. LeBlanc, long-time U. S. Marshal, now retired, is present Chief of Law Enforcement. Easterly's long background as a former sheriff of Livingston parish and as Warden of the Louisiana State Penitentiary, at Angola, has evidenced itself by the record the department has made not only for major arrests but also in the prevention of law violations.

Working directly out of headquarters, under Eastrely, are: Julius Book, Assistant-chief of Law Enforcement; Anthony Berni, in charge of records; and, Ben C. Dahlen, D. L. Farrar, Lesma Hebert and Frank Trocchiano. The five men have had an aggragate service of 125 years with the Law Enforcement division.

Among the notable achievements of the Law Enforcement Division, which gained for it commendations both in the local and national press, was the immediate response of the division's personnel when the crews of two of the commission's planes and 32 boats were sent into the aftermath of Hurricane Audrey, under orders from Director F. Lamar Clement.

JULIUS L. BOOK
Assistant Enforcement Chief

The more than 100 men of the Law Enforcement Division were the first to enter the storm torn area under the supervision of Rudolph P. Easterly, Chief, who directed the operations on that fateful day of June 27, 1957.

During the 24 hours that preceded the arrival of Hurricane Audrey, Chief Easterly had withdrawn his boats from the danger area and held his men in wait to go into action. As Audrey lost herself to the north, the men went feverishly to work getting into the Cameron area. The commission's 300-foot radio tower at Pecan Island had been blown away, however, other communication towers, also put out of commission, were immediately re-activated. Meanwhile Easterly was receiving frantic calls from Abbeville advising that the people of Cameron parish were without food and water and that hundreds of survivors were clinging to debris over the marshlands. At Abbeville the power for the radio station had gone out but the ingenious station operator had connected his automobile generator to the station and calls were getting out. At Baton Rouge, Easterly dispatched enforcement captains and game agents from all over the state to the disaster area and all radio towers were alerted to stand by.

They arrived by plane, automobile, trucks and boats and marshalled in and around Abbeville and at Chief Easterly's signal moved into the wake of the storm.

Then began the feverish operations to get to the survivors. The commission's two amphibious planes moved in on the commission's Fur and Game refuge at Pecan island and began the rescue of 80-odd persons who they picked up from the wreckage spread over the marshes and ferried to Lake Charles. The planes sent from New Orleans by Chief Pilot John Ellington were manned by Pilot Nat Pedro and mechanic John McGovern and Pilot Preston "Buck" Davis and Tom Clements, a special agent, who had volunteered to serve as mechanic.

On return trips from Lake Charles the planes brought water and gasoline for the small boats operating in the area. There was no time to stop or eat, the main objective was to get the living from the snake infested masses of wreckage. There was no time then for the dead and men went 12 hours without stopping. On land, the crews encountered telephone poles and wires which cluttered the roads. Masses of dead cattle, alligators, snakes, nutria, muskrats blocked the intra-coastal canal at points. Obstacles for the 30 small boats were many and work went on 'round the clock.

"We didn't let up until we got every live person off the Pecan island area and then we started looking for the dead.

The Navy and Coast Guard were working side by side with us by then and we started spotting the dead and the planes put down markers . . . there wasn't time to pick them up . . . ," Pilots Pedro and Davis said. Another pilot who figured heroically in the rescue work was J. H. Lamb, Jr., of Lafayette, pilot of the Pan-Am Oil Company's amphibian. "He was along with us all the time, we don't know how many he saved," they said.

Meanwhile at New Orleans a full crew manned the radio tower relaying messages and dispatching aid. The men, headed by Assistant Chief Julius Book, were Anthony Berni and Agents B. C. Dahlen and Frank Trocchiano. None left their stations for the duration. Late in the day, Captain Book received a call from Abbeville that typhoid serum was badly needed for the victims. Agents Frank Trocchiano and Louis Barattini immediately contacted Dr. George Hauser of the Board of Health of New Orleans and made connection with an Eastern Air Lines plane which flew the needed serum to Abbeville.

"It would be hard to choose from among our men just who did the most. We regard all of them as unsung heroes," Director Clement said. "Our men as far as we know were the first to get into the area and many of them remained there helping to prevent looting and worked with the Civilian Defense people and the sheriff," he said.

Among the injured was Game Agent Daniel Roux, of Cameron, Arnold Rutherford, another game agent, lost his wife in the storm, and Dupreville Bertrand, agent for the Fur and Refuge division was killed.

According to Rutherford, he had been making preparations to evacuate his wife and child and to join the other agents when at 4:00 a.m. the water began to rise in his front yard. "Suddenly," he said, "the whole house started to float and then it disintegrated." He then climbed to the top of the floating roof with his wife and child and was holding on to them by their hands when a wave came along and swept over them. He succeeded in holding on to the child, but his wife slipped away and he did not see her again.

Those agents of the enforcement division of the Wild Life and Fisheries commission who have been commended by State and Federal agencies and Director Clement for their work during the emergency, are:

FRANK TROCCHIANO
Agent III

Chief Rudolph P. Easterly, Asst. Chief J. L. Book, Capt. Anthony Berni, Game Agent B. C. Dahlen and Game Agent Frank Trocchiano of New Orleans; Capt. Dewey L. Farrar, of Shreveport; Capt. Lesma Hebert of Labadieville; Capt. Thomas D. Rayburn, of Bogalusa; Capt. Clarence Hood, of Jonesboro; Capt. Charles Ventrella, of Bachelor; Capt. Leonard C. New, of Kentwood; Capt. Joseph L. Billiot, of New Orleans; Capt Joseph J. Waguespack, of the boat "Pintail" of New Orleans; Capt. George A. Chiasson, of the boat Safety Craft, of Abbeville; Game Agents Wm. G. Barnette, of Vivian; Jack Stanfield, of Minden; Earnest O. McCoy, of Ringgold; Alfred Couvillion, of Simmesport; Regile Doucet, of Washington; Hyrum Lee Martin, of of Washington; Coleman Fontenot, of Eunice; Andrew L. Jackson, of Melville: Honore Tate, of Lawtell; Wilfred Bonaventure, of New Roads; Vincent Purpera, of Innis; E. J. Cormier, of Lafayette; Noisey P. Begnaud, of Carencro; Ivy J. Hanks, of Morse; Lester J. Hebert, of Crowley; Melvin Dupuis, of Breaux Bridge; Robert Romero, of St. Martinville; George T. Bunch, of Clinton; Ben A. Price, of Ethel; Nick Niehaus, of Ponchatoula; Huey S. Bardwell, of Innis; E. J. Cormier, of Lafayette; Noisey P. Begnaud, of Varnado; Thomas Kemp, of Bogalusa; Bradley W. Herrin, of Pearl River; A. D. Parker, of Covington; Arthur Jenkins, of Covington; Charles R. Harris, of Denham Springs; L. U. Jarreau, of Baton Rouge; Harold Schexnayder, of Sorrento; Lloyd C. Andrus, of Lake Charles; James F. Ellis, of Sulphur; Bernett Jardell, of Sulphur; Daniel Roux, of Cameron, INJURED; Arnold Rutherford, of Cameron, INJURED & LOST WIFE; Milton Lege, of Abbeville; Theodore Bonin, of Avery Island; Melvin Duhon, of New Iberia; Everette Fouquier, of Franklin; Cecil Gilmore, of Berwick; Cullen Landry, of Paincourtville; James V. Jaccuzzo, of Houma; James Waguespack, of Houma; Lloyd Songe, of LaRose; Dupreville Bertrand, of Grand Chenier, DEAD; Aviators Nat Pedro, John McGovern, Preston "Buck" Davis, and Tom Clements; John Ellington, Chief Pilot.

ANTHONY BERNI
Agent III

Another sensational move by the enforcement division was the breakup of what agents believe was a conspiracy by captains of three shrimp luggers to invade the Pass-a-Loutre game refuge to slaughter boatloads of deer and offer the game for sale. The hunters had no dogs with them but were equipped with searchlights that could have been used for night hunting.

Discovery of the "invasion" came when agents surprised LeRoy Bruce, of Cut Off, with two illegally slain animals in his possession in the sanctuary. The arrest developed into the discovery by Captain Julius Book, Assistant Chief of the division, that three shrimp luggers had anchored in the refuge and had sent out men in pirogues to hunt the animals. Bruce was one of them, the others escaped into the shoulder-deep, near-freezing swamps. However, not before they had jettisoned five more slain animals and abandoned their pirogues. The deer were taken as evidence. As a result of the foray three captains and their three helpers were charged in Plaquemines parish with hunting and killing seven deer in closed season on Pass-a-Loutre reserve.

Concerning the Pass-a-Loutre incident the Baton Rouge Morning Advocate commented, "If the situation is what the wardens (agents) believe it to have been, the offense is about as brazen as any of the kind we have heard about in quite awhile . . . it was 'sportsmen' of that kind that made strict conservation laws necessary in the first place. They are the first cousins to the slaughterers of the buffalo who rendered the species almost extinct, to the hunters who slew the passenger pigeons by the millions by setting dynamite charges in their roosting areas, and the killers who used their huge shrapnel-loaded shotguns, large as a cannon, to bring down whole flocks of ducks."

"They are the dynamiters of the past who hauled in game fish by the ton and the scientific scoff-laws of today who use an electric charge to clear large bodies of water of all fish.

"Game conservation laws now in effect are the product of necessity and long years of experience and have stood the test of time. They are neither arbitrary or unduly stringent. They deserve the cooperation of every citizen who is interested in fishing and hunting."

First arrest in an attempt to break up the wide-spread selling of game fish in Lake Bistineau came when game agents apprehended A. N. Tooke, veteran camp operator and charged him with the illegal sale of game fish.

Tooke's arrest came after two months' undercover work by game agents Al Prechac, Earl Gorio, Captain Leonard New, and Thomas D. Rayburn of the law enforcement division.

The special investigators were sent to the Bistineau area by Wild Life and Fisheries Director F. Lamar Clement.

The 69-year-old Tooke, who is said to be the first camp owner on the lake, was arrested by Rayburn after he had made his third purchase. Rayburn said that he and the agents went to Tooke's camp and told him they wanted more fish and that when Tooke placed the fish in their ice box they arrested him. He said that Tooke had been selling the bass for two dollars each, and the white perch for a dollar each. He said none of the perch he bought weighed less than two pounds and the bass weighed as much as five and a half pounds. Each of the fish purchased contained eggs, he said. The number of game fish sold by Tooke was estimated by the game agents at from 15,000 to 20,000 per year.

Wild Life and Fisheries game agents are shown with this powerful shocking machine which practically fried the fish when used in the Amite river by four men who are out on $8000 bail for the offense. Above, left to right, are agents Prestley R. Mack, Charles R. Harris, Captain Leonard C. New, with a 36 pound blue catfish taken in the haul, and Agent Harold Schexnayder. Other agents on the arrest not in the picture were Mack Sanders and E. J. Milton.

Commercial fishermen are permitted to take non-game fish from the lake provided they have the proper licenses and use nets of legal size.

The largest individual fine was assessed Rufus Jones of Bogalusa. Jones, a "two-time loser," was fined $650 or a total of 210 days in jail when Judge Fannie E. Burch found him guilty before her on three charges of game law violations.

Jones had been found guilty once before of killing deer at night. This time the woman judge fined Jones $500 or 90 days in jail for killing a deer in Zemurray Park, a state game refuge; he was additionally fined $150 or 30 days in jail for killing a fawn deer.

One of the features of Jones' arrest was a sensational automobile chase by game agents during which Jones and a companion, Richard Kuhn, also of Bogalusa, drove their car more than 100 miles per hour in an effort to evade their captors. Kuhn was caught at a road block set up by state police, deputy sheriffs, and game agents outside Bogalusa. Jones who had escaped during a slowdown in the chase, was arrested later. Kuhn, as driver of the car was fined $25 and cost of court or 30 days in jail by Judge Horace Reed at Amite.

B. C. DAHLEN
Agent III

Highest fine was $2700 meted out to nine hunters from Alabama by Federal District Judge Herbert Christenberry. The men were apprehended when state agents swooped down on their yacht, the Azalea Queen, in the commission's plane and caught the men with 188 ducks in their possession.

The men who were members of a party of 13, had gone to the Chandeleur Island area on the 110-foot yacht Azalea Queen, and were in duck blinds when the plane seeming to come from nowhere landed beside the yacht.

Headed by Captain Julius Book, the game agents boarded the vessel and found no one aboard. However, Captain Book said some of the 188 ducks found were stuffed in ice boxes and some were already drawn. Hearing the plane's motors, the hunters came out of the blinds and boarded the yacht and were arrested for having too many ducks in their possession. Three of the men in the party were additionally charged with having improper hunting licenses and two others, who "begged off" on the plea that they were not hunting but fishing, were found with 14 speckled trout in their boat but with no ducks. They were charged with having no fishing licenses.

Captain Book, who was accompanied on the raid by agents Courtney Bienvenue and pilot-agent Nat Pedro, along with Federal agent Ralph Harris, said that the men admitted the violations. They were released after signing releases for the ducks. "They told us they knew they were violating the law by taking an over-limit of ducks, but they just couldn't stop shooting," Book said.

All in the party with the exception of the two fishermen William Bayley and Edgar L. Graham, were charged with the hunting violations, and with hunting on a bird sanctuary.

Arrested were: Ernest M. Merriwether, Thomas O. Howell, Jr., Air Force Captain Sewell Simonson, W. Stuart Ramsey, Jr., and Alvey Glenn Anderson, all of Mobile; Buford Bryant, Kenneth Kerby, James Freeman, Lester Bryant, and Edgar L. Graham, all of Bayou La Batre; Francis Asbury Wilkinson of Montgomery; William Bayley, Theodore and Derrill A. Stuart of Bay Minette.

Fish shockers, that tribe of "good sports" who never believe in giving a sucker an even break were the target of crackdowns throughout the state and arrests for 1956 and 1957 showed a decrease of 13 cases in 1957.

"The enforcement division went the 'whole hog' with planes and fast boats in areas where fish shocking was known to be most widespread and we are glad that we have been able to curb this practice," Chief Easterly said.

Most flagrant of the fish shocking violations was in Washington parish where Special Agent J. C. Loveless of the Wild Life and Fisheries commission was fired upon three times by violators while attempting to bring in two men.

According to Loveless, he was doing some sleuthing on Pearl River in the early morning when he found Donald Kelvin Deakles, age 29, who gave a Los Angeles address, although he is known to be residing in Mississippi, and Thomas Jack Sullivan of New Augusta, Mississippi, with a shocking machine, motor boat and two dip nets. He said he took both men to their car and then put the confiscated equipment into his truck parked nearby. He said he told them to get into their car and follow him to Covington where he planned to book them on the fish shocking charge.

Loveless said that when he started walking away from the pair toward his truck, three shots were fired behind him in quick succession. The agent said he "hit the dirt" immediately.

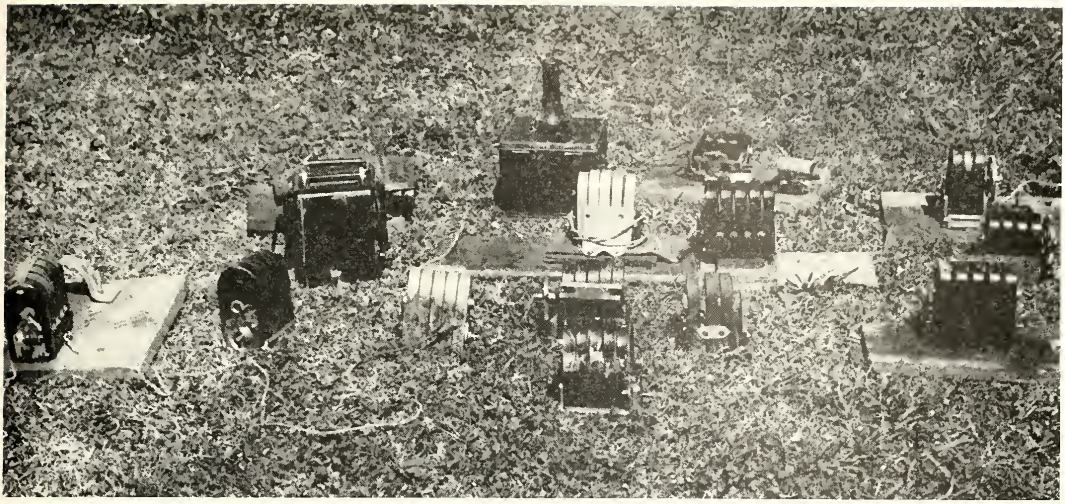
Almost at the same moment, Loveless said, the two men sped away in their car. Loveless had the license number of the sleek new automobile, however, and radio broadcasts were sent out for officers in the area to be on the lookout for the men. The Mississippi Highway patrol and Forest county sheriff's office were also put on the alert.

Several hours after the incident, Captain Thomas D. Rayburn of the Wild Life and Fisheries' enforcement division, who had been searching for the men, was radioed by Inspector Gray of the Mississippi Highway patrol that he had run down the men several miles east of Hattiesburg after a chase in which the speed of both cars reached 120 miles per hour.

Captain Rayburn, with Game Agent Thomas Kemp of Bogalusa and Loveless, proceeded immediately to Hattiesburg and picked up the men who admitted using the shocking machine but denied shooting at Loveless. The two men also admitted speeding away from Loveless. Inspector Gray said that when he got out of his car, following his 120-mile-an-hour chase, he went to Sullivan with gun drawn but neither men offered any resistance.

Agent Loveless said that the bullets from the gun, which he said was a pistol, probably whizzed by him in the air because he was unable to find any trace of the slugs. It was still dark when Loveless took the two men into custody for

A haul of 52 dozen sac-a-lait made by game agents Sterling Hebert and Charles Olano at Lake Murphy in Iberville parish, when they arrested Randolph Pearce of Plaquemine, Louisiana. Left to right in the picture are: Sterling Hebert, Charles Olano and Captain Lesma Hebert, District Supervisor.



Shown above are numerous fish-shocking devices that have been confiscated by the enforcement division of the Louisiana Wild Life and Fisheries Commssion.

a few moments making him a hard target to hit, he added. The officers said they found no gun on Sullivan or Deakles nor was there one in the car when they were apprehended. However, Captain Rayburn said he had learned that the men had stopped and visited some friends before they were arrested.

Both men were returned to the Covington jail after waiving extradition in Mississippi to Louisiana where they were charged with shocking fish with an electrical device.

Largest bond ever set for fish-shocking violations was made by four offenders who were released on bonds totalling $8000 for shocking and taking catfish in the Amite river.

According to Captain Leonard C. New, of the enforcement division, who led the raiding party with Agents Prestley Mack, Mack Sanders, E. J. Milton, Charles R. Harris and Harold Schexnayder, the fish shockers taken in this arrest literally "fried" the catfish taken with a super powerful shocking machine powered with two six-volt auxiliary batteries. "Every one of the 24 catfish confiscated from the fish shockers was seared with large red blisters and their fins were burned crisp, so powerful was the charge sent out between the electrodes," New said.

Those arrested with the catch, which totalled 111 pounds, and which included a 36-pound blue catfish are: Ellis Smiley and Roland LeBeau of Prairieville; Sidney Joseph Vaugn, Jr., and Stanley Alfred Landry of Plaquemine.

The main function of the Division of Law Enforcement is to enforce all fish and game laws and to provide protection to all of Louisiana's wildlife resources. To this end the state has been divided into two sections comprising nine districts of about equal areas. Headquarters are in the newly-acquired Civil Courts building in New Orleans at Royal and Conti streets.

The Northern Section is coordinated by a Wildlife Agent III who resides at Shreveport, Louisiana, and is made up of four districts comprising the parishes of Bossier, Caddo, DeSoto, Red River, Claiborne, Webster, Bienville, Jackson, Union, East Carroll, Morehouse, West Carroll, Richland, Lincoln, Ouachita, Natchitoches, Sabine, Vernon, Rapides, Grant, Winn, Madison, Tensas, Franklin, Caldwell, LaSalle, Catahoula and Concordia.

The Southern Section, coordinated by a Wildlife Agent III residing in Labadieville, is made up of five districts, comprising the parishes of Beauregard, Allen, Jefferson Davis, Calcasieu, Cameron, Avoyelles, Evangeline, St. Landry, Pointe Coupee, West Baton Rouge, Iberville, Lafayette, Acadia, St. Martin, West Feliciana, East Feliciana, St. Helena, Tangipahoa, Washington, St. Tammany, Livingston, East Baton Rouge, Ascension, Vermilion, Iberia, St. Mary, Assumption, Terrebonne, Lafourche, St. James, St. John the Baptist, St. Charles, Jefferson, Plaquemine, St. Bernard and Orleans. These two Agent III's receive their orders and instructions direct from the main office in New Orleans. Their duties are to coordinate the various districts under their supervision in order that all 64 parishes may operate as one.

The state is further divided into nine law enforcement districts, each district is supervised by a Wildlife Agent II, who receives instructions and policy from either the Wildlife Agent III or at the main office in New Orleans. It has been found that this arrangment adds greatly to the efficiency of the men in the field. At present there are 177 men connected with the Enforcement Division who devote their full time to law enforcement.

Every agent connected with the Law Enforcement division is supplied with a boat, motor and trailer to suit the requirements of the particular terrain. There are 28 state owned automobiles being operated in the field at this time and 98 two-way radios are in operation in both state and personally owned vehicles.

The salaries of all Agent I's have been increased by Civil Service from $280 to $295 per month. This, along with the requirements set forth by Civil Service has assured the division of a high type worker as Agent.

The Enforcement Division has returned to khaki uniforms in addition to law enforcement work agents are expected to do public relations and educational work through out the state.

The following large boats are being used by the Enforcment division for coastal patrol to enforce laws and regulations pertaining to commercial fishing and shrimping: Black Mallard; Safety Craft 192; Safety Craft 193; Safety Craft 213; 20-U-19; Zoric; Barracuda; Wahoo; Pintail and Tarpon.

It is anticipated that the following equipment will be needed to replace old and obsolete equipment and add to the equipment already in use in order that the division may meet the rising enforcement problems which now confronts it: 26 automobiles; one 1½ ton truck; 50 two-way car radios; 60 boat trailers as replacements; approximately 50 trailer tongues as replacements for trailers now in use which are unsafe; 25 pairs of wheels for boat trailers; 200 trailer tires; 40-7½ horse-

Eleven Alabama men were arrested December 1956 in possession of 188 ducks when game agents swooped down by plane on their yacht near North island in the Chandeleur group. With the ducks seen above are members of the raiding party, left to right, Game agent Courtney Bienvenue; Ralph S. Harris, U. S. Game agent; Captain Julius L. Book, Assistant-Chief of Law Enforcement for the Wild Life and Fisheries Commission who led the raid, and Nat Pedro, Game agent and pilot. Most of the illegally taken ducks were red-heads.

power outboard motors; 20-35 horsepower outboard motors and 15-50 horsepower outboard motors for shrimp patrol in coastal waters; 50-18 horsepower outboard motors for patrol work in the interior of the state; 20-12′ speed hulls; 15-16′ speed hulls; 2-110 diesel engines, and radio parts for repair and maintenance of existing two-way car radio sets now in use.

Also anticipated is the purchase of three additional jeeps. These jeeps are vitally needed in Avoyelles, Concordia, Catahoula, Tensas, Madison and other parishes where swamps are inexcessible to automobile travel.

As the inroads of civilization are constantly increasing enforcement problems, it therefore becomes necessary that equipment be able to excel that used by violators. Need for better and faster motors, boats and cars may readily be seen if the present standard of enforcement is to be maintained.

At the present time the Wild Life and Fisheries commission maintains 22 radio towers located at the following points: Grand Pass, Bay Gardene, Pass-a-Loutre, State Wildlife, Marsh Island, Sister Lake, New Iberia, Abbeville, Pecan Island, Rockefeller, Opelousas, Baton Rouge, Franklinton, New Orleans, DeRidder, Red Dirt, Alexandria, Ferriday, Minden, Monroe, Sabine Pass and Grand Terre.

The aforementioned provide statewide radio coverage and contact with the department's radio equipped cars, boats and planes. Additional walkie-talkie and handy-talkies equipment is also employed for communication.

The division likewise operates a wharf located at West End Boulevard, where motor boat repair and maintenance work is done. Airport facilities are also maintained at the commission's hangars at New Orleans airport where the planes are housed, repaired and serviced.

The following is the record of violations for the years 1956 and 1957:

VIOLATIONS BY PARISHES

PARISH	1956	1957
Acadia	8	27
Allen	10	16
Ascension	33	34
Assumption	25	21
Avoyelles	77	87
Beauregard	8	11
Bienville	36	29
Bossier	38	55
Caddo	98	40
Calcasieu	50	70
Caldwell	6	8
Cameron	24	47
Catahoula	24	15
Claiborne	4	4
Concordia	38	30
DeSoto	20	13
East Baton Rouge	32	7
East Carroll	15	6

VIOLATIONS BY PARISHES—(Continued)

PARISH	1956	1957
East Feliciana	9	2
Evangeline	34	32
Franklin	9	6
Grant	29	13
Iberia	33	36
Iberville	32	38
Jackson	4	1
Jefferson	89	164
Jefferson Davis	22	16
Lafayette	30	23
Lafourche	43	33
LaSalle	2	12
Lincoln	6	14
Livingston	51	45
Madison	16	35
Morehouse	45	20
Natchitoches	38	38
Orleans	17	44
Ouachita	15	27
Plaquemines	16	86
Pointe Coupee	43	25
Rapides	60	34
Red River	10	4
Richland	36	11
Sabine	8	1
St. Bernard	51	80
St. Charles	32	17
St. Helena	3	11
St. James	17	39
St. John the Baptist	20	15
St. Landry	66	66
St. Martin	44	33
St. Mary	47	37
St. Tammany	167	54
Tangipahoa	58	77
Tensas	35	26
Terrebonne	19	35
Union	7	8
Vermilion	32	52
Vernon	11	4
Washington	19	38
Webster	18	3
West Baton Rouge	6	8
West Carroll	9	9
West Feliciana	13	4
Winn	4	6
	1921	1902

TYPE OF VIOLATION	1956	1957
Angling without license	311	4
Commercial Fishing Without License	40	30
Selling Fish Without License	19	3
Electrocution of Fish	39	26
Trawling Without License	8	1
Trawling at Night	1	17
Trawling for Crabs	3	6
Trawling in Closed Waters	99	221
Seining in Closed Water	5	1
Possession of Undersized Fish	6	10
Possession of Over Limit Game Fish	14	27
Possession Game Fish for Sale	9	8
Possession Undersize Shrimp	23	11
Possession Undersize Crabs	4	9
Taking Alligators in Closed Season	4	3
Possession Over Limit Migratory Waterfowl	31	30
Possession Illegal Deer Meat	16	8
Hunting Migratory Water Fowl Illegal Hours	49	41
Selling Migratory Water Fowl	....	1
Hunting and Killing Woodduck	26	1
Hunting Migratory Waterfowl Closed Season	16	41
Hunting Migratory Waterfowl without duck stamp	9	12
Hunting on State Preserve	25	51
Hunting Without License	96	88
Hunting at Night	302	396
Hunting With Unplugged Gun	43	57
Hunting Quail in Closed Season	8	14
Hunting Squirrel in Closed Season	192	180
Hunting Dove Illegal Hours	5	5
Hunting and Killing Dove from Automobile	1	8
Hunting at Night from Automobile	....	10
Possession Over Limit of Squirrels	8	1
Possession Over Limit of Rabbits	....	7
Possession Over Limit of Doves	12	13
Hunting Dove in Closed Season	42	32
Killing Doe Deer	32	46
Trapping Song Birds	....	1
Hunting Deer in Closed Parish	7	4
Hunting Deer in Closed Season	23	39
Hunting Deer on Public Roads	5	4
Hunting and Killing White Ibis	....	1
Hunting Frog in Closed Season	22	34
Hunting Frog in Illegal Methods	11	11
Hunting Rabbits in Closed Season	41	66
Hunting Turkey in Closed Season	6	11
Hunting Snipe in Closed Season	3	1
Hunting and Killing Grosbec	9	18
Hunting and Killing Rail in Closed Season	2	6
Hunting and Killing Crane	2	1
Fishing Game Fish Illegal Tackle	72	59
Fishing Commercial Fish Illegal Tackle	26	27
Fishing Without Non-Resident License	48	102
Fishing With Explosives	3	2
Commercial Fishing in Closed Waters	1	2
Hunting Fur Bearing Animal With Gun	16	10
Hunting Fur Bearing Animal With Dog	1	5
Hunting from Power Boat	45	23
Hunting and Killing Robins	2	5
Trapping Without License	....	7
Trapping Out of Season	7	14
Trapping on State Preserve	....	1
Camping on Refuge	6	2
Pollution of Stream	1	1
Blocking of Stream	9	19
Taking Oysters from State Leased Bedding grounds	....	3
Shooting Fish	....	2
Operating Hunting Club Illegal	....	2
Hunting Mig. Water Fowl in Baited Pond	1	....
Hunting and Killing Hen Turkey	5	....
Hunting Woodcocks in Closed Season	1	....
Resisting Arrest	4	....
Transporting Fish Out of State Illegal	4	....
Hunting on Private Property	4	....
Firing the Feeding and Breeding Ground of Wild Birds and Wild Quadrupeds	9	....
	1921	1902

The following is a list of total fines collected in Justice of the Peace courts, District Courts and Federal Courts during the years 1956-1957 for game law violations:

Justice of the Peace Courts	$ 60,808.06
District Courts	$ 17,580.00
Federal Courts	$ 13,720.00

Fines collected in the J. P. Courts are turned over to the Parish School Boards.

In addition to the fines mentioned above, violators of the fish and game laws served a total of 2,455 days in jail.

WATER POLLUTION CONTROL DIVISION

K. E. BIGLANE

Chief

THE present day story of Louisiana's water pollution control authority begins in the Geology Building on the L. S. U. campus in Baton Rouge. There, the Division of Water Pollution Control makes its home amidst the most modern of chemical and biological laboratories to be found anywhere. This is the only organization of division strength to be located outside of the Wildlife and Fisheries Commission family in New Orleans. The reason for this location dates back nearly 20 years when Wildlife and Fisheries was once a part of the Department of Conservation. At that time the Geology Building was being constructed on the relatively new L. S. U. campus with financial aid and equipment from the then Department of Conservation. In return for this aid offices and laboratory space were reserved for several of Conservation's divisions, the Division of Research and Statistics being one of them. A 1938-39 Biennial reveals that this Division was composed of six Bureaus, namely, Civil, Petroleum and Chemical Engineering, Biology, Statistics and Education. Since water pollution control was one of the primary aims of this organization, its name was recently changed to signify this because pollution research and control has become its main function. The six Bureaus comprising the Division have long ago been dissolved but the overall scope has been expanded with regard to water quality control and analysis.

The Division's residence on the State University Campus has been both profitable and enjoyable. Profitable from the standpoint of scientific research assistance by University professors and the use of the library and other facilities. Enjoyable from the standpoint of our pleasant association with the University staff and the prevailing formal academic atmosphere that makes itself felt in our laboratories.

The Division staff regularly attends and participates in technical seminars and symposia sponsored by the University.

We believe the University has in turn benefited from the association for the Division has provided technical services for the staff and students in engineering, agricultural, and biological sciences. The Division's research personnel actively administer to graduate fellowships given by industry to study problems in waste control. Two such fellowship students, sponsored by the Louisiana Petroleum Refiners Waste Control Council, use the biology laboratory and the Division provides them with living organisms for study as well as scientific equipment and data. Since 1948, two Doctorate Degrees and four Master of Science Degrees have been awarded students holding these fellowships. After receiving their degrees, three of these fellowship students joined the technical staff of this Division. Thus, the State has materially benefited by participation in this form of science education assistance. These men did not have to receive on the job training in the science of water pollution research and control, instead they became valuable observers from the very start. Our national education system is sadly neglecting the field of industrial waste control primarily because there are so few trained men in this science field.

K. E. BIGLANE

One of the Division's most important duties is to act as a fact finding body for the Stream Control Commission, an agency set up by the 1940 Legislature to control, regulate, or restrain the discharge of any waste material into any waters of the State. As one can well imagine, the Stream Control Commission has been unusually active during the past two years in reviewing applications for permits to discharge submitted by new industries, expansion of existing industries and municipalities, increasing changes in the uses of State watersheds, and the continuous pressure to upgrade water quality statewide.

In its short history, the Division has made several important contributions to the science of waste control. The most notable to date is the standardization of the bioassay test using fishes. During the war years two of the Division's Biologists, Dr. Peter Dudoroff and Dr. John Greenbank collaborated with Dr. Bregy Hart of the Atlantic Refining Company and devised certain equipment and testing procedures for determining the tolerances of fishes to various substances which might be found in an industrial effluent. These procedures are now universally accepted.

Investigations of streams and rivers using biological fauna as an index to the severity of pollution was also started about this same time and is being used in our present day methods. Although this technique was not devised in Louisiana, its use has greatly enhanced the understanding of the ecology in our southern waters.

Many technical papers have been written by the personnel of the Division and as a result of their wide distribution, correspondence has been received from several foreign nations requesting an opportunity for their workers to study in our laboratories and observe our techniques for pollution control.

In June of 1957, a Formosan Sanitary Engineer spent two weeks in Louisiana's sugar cane grinding area. His country produces nearly one million tons of sugar annually and the pollution problems connected with these operations are more serious than Louisiana's because of the lack of water in their receiving streams. The Division's success in abating this type of pollution can be measured by the number of streams which are not now affected from this source.

In October of 1957, a Professor of Fisheries at the University of Kyushu, Kyushu, Japan requested permission to study in the Division's research laboratory for a period of six months at his government's expense. In his application this scientist stated that while doing literature research in the field of water pollution, he found that Louisiana's workers were doing the type of field and laboratory studies the Japanese desired to duplicate. After spending a short period in the Sanitary Engineering School of the University of Florida and Purdue University, this Professor will begin his studies in the Division laboratory in June, 1958.

The Stream Control Commission

As was stated earlier, the Division of Water Pollution Control provides the Stream Control Commission with all of the technical data and other necessary facts needed by this Board to carry out their prescribed functions. In addition, the Division Chief serves as technical advisor and Executive Secretary for this Commission since it has no budget and consequently no money to support a staff or even reimburse its own members for their incurred expenses. The Commission, however, is a very efficient and integral part of our government for it is with this board that the State must entrust its greatest natural resource-water. By maintaining purity in the State's streams and rivers, municipal populations can continue to grow, industrial expansion can continue at its present pace, and water for agriculture, recreations, and wildlife will be assured for the future.

The Commission represents the interests of several other State agencies since it is composed of the Director of the Wildlife and Fisheries Commission, who acts as ex-officio chairman, the President of the State Board of Health, the Commissioner of Agriculture and Immigration, the Commissioner of Conservation, the Executive Director of the Department of Commerce and Industry and the Attorney General or their authorized representatives.

The Commission's primary function is to "Control waste disposal, public or private, by any person, into any of the waters of the state or any tributaries of drains flowing into any of such waters, for the prevention of pollution thereof tending to destroy fish life or to be injurious to the public health, the public welfare, or to other aquatic life or wild or domestic animals or fowls." To attain this end, the Commission may: (1) Establish pollution standards for waters of the state in relation to the public use to which they are or may be put as it deems necessary. (2) Base its orders on the high and low water stream flows. (3) Restrain the discharge of any waste material discharged or sought to be discharged into any water of the state. (4) Prohibit any discharge resulting in pollution which is unreasonable and against the public interest in view of the existing conditions in the waters of the State.

In order to prevent water pollution by new industry locat-

The Stream Control Commission in action. Considering a matter before a public hearing are (left to right), Mr. L. Gibbs Adams, Commerce and Industry; Mr. Ernest Epps, Agriculture and Immigration; Mr. Lamar Clement, Chairman, Wild Life and Fisheries Commission; Mr. K. E. Biglane, Executive Secretary; Mr. Harry Fuller, Attorney General; Mr. John Trygg, Department of Health; Mr. Leo Hough, Department of Conservation; and Mr. Earl Christenberry (foreground), Recorder.

A witness gives testimony in the Federal interstate pollution action on the Corney Drainage Basin involving Arkansas and Louisiana. Members of the Hearing Board are shown in the foreground and the Attorneys for the U. S. Department of Health, Education and Welfare are at the small table to the left. Maps showing areas in Louisiana affected by Arkansas oil field wastes are seen in the upper righthand portion of the photograph.

ing on or near the banks of a state waterbody, the Commission has a regulation making it mandatory for such an industry to secure a permit to discharge its wastes. The permit is considered on the basis of engineering data submitted by the new plant. After the Division's biologists and chemists have reviewed these plans, their recommendations together with any changes they believe necessary are submitted to the Commission at a public meeting. All persons that may be affected by virtue of a downstream location are notified of this meeting and are allowed an opportunity to voice their opinion. After all of these factors are considered the Commission either grants, denies, or withholds the discharge permit pending further study by the Division's technical staff or the Commission's membership. If a permit is granted the liability of discharge remains with the industry and if trouble arises as a result of their discharge at any future date, the industry is required to take the necessary steps to eliminate the pollutants.

During the biennium the Commission met on 14 occasions and considered over fifty requests to discharge wastes from new industry, expanding industry, municipalities, and industries altering the quantity or quality of their effluents.

Their requests ranged over a myriad of industry and encompassed new paper mills, new food processing plants, plastic and other petroleum by-product manufactures, metal manufacturers, sub-surface resource miners, oil and gas refineries, in short almost every conceivable type of industry that is found in Louisiana had one or more requests for consideration by the Commission.

Over fifty oil leases were cited by the Commission as being a source of real or potential pollution. Three sugar cane factories, two potato plants and a slaughter house were also given determinate orders. A public hearing was held involving all sugar cane mills and this industry's problems were aired.

In all, this has been one of the busiest biennia in the history of the Commission and their success in combating stream pollution in general can be measured by the increased miles of unpolluted water found in the State.

There are several old problems still to be met. Certain water areas of the state are continuing to receive oil field wastes, partially treated paper mill effluents and municipal sewage. Up until now the expensive treatment costs and the overall economics of the situation have deadlocked some of these issues. But, with the nations top census and industrial forecasters predicting a national population of 220 million people as of 1957, and an increase in water consumption from a present 450 billion gallons per day to 597 billion gallons per day in 1980, all of Louisiana's streams must be readied for legitimate uses if the state intends to keep pace with the rest of the country in population growth, industrial expansion, and recreational facilities.

Classified Duties of Division Personnel

The very name of the Division reveals its primary function, that is to maintain a high grade of water quality, by research and enforcement, in all of the waters of the state by its own actions and through the Stream Control Commission. To achieve this end the staff is composed of technicians that utilize various yardsticks to measure the extent of damages inflicted upon a stream by industrial or municipal wastes, or natural phenomena resulting in water pollution.

The Division's Biologists, numbering three including the Division Chief, interpret the extent to which aquatic animal populations may have been affected by wastes. This may include a survey of the small micro and microscopic, nonvertebrate forms which are a very necessary link in the food chain of fishes. The vertebrates, mainly the fishes, are surveyed by current census methods in an attempt to determine how their populations may have been affected by a chemical or physical change in their habitat. Biological assay tests using live fishes and lower forms are conducted to determine the safe concentrations of industrial wastes and/or pure chemicals in a receiving stream.

Once the extent of danger to a receiving waterbody is determined, these data may be passed on to the Division Engineer who calls upon the industry and makes recommendations for waste treatment measures. This may include calculating the size of a waste stabilization impoundment, figuring the amount of material to be discharged based on stream flows, modifying or otherwise altering effluent components, calculating costs of treatment by the addition of chemicals, or recommending certain types of devices to be used inside an establishment for the reduction of waste materials. As one may well imagine, the services of this individual is highly limited for it is our philosophy that waste treatment is strictly an industry and municipal responsibility. No effort is spared, however, to assist in these responsibilities and every request for assistance, no matter how large or small, has been acted upon.

One of the most important sections in the Division includes

The Hearing Board in Homer, Louisiana in January, 1957, evaluates testimony involving the first Federal interstate pollution action ever to be held. As a result of the recommendations of this Board, the Corney Drainage Basis was relieved of its pollution load from Arkansas oil fields. The Board members are (left to right) K. E. Biglane, Louisiana Wild Life and Fisheries Commission; Blutcher A. Poole, Indiana State Board of Health; Chester S. Wilson, Chairman of the Hearing Board, Minnesota Conservation Commission; H. C. Jackson, U. S. Department of Commerce; and Glen T. Kellogg, Arkansas Water Pollution Control Commission. (Photo by J. E. Hampson) the Waste Disposal Inspectors. These men furnish up to the minute information on most of the waters of the state and they are generally the first to notice changes in a stream's chemical or physical character. There are eight Waste Disposal Inspectors strategically located throughout Louisiana and they give as much area coverage as possible involving all types of industry.

The Inspectors are furnished with automobiles equipped with two-way radios and portable water chemistry kits. These kits allow for a quick testing of the stream's "general health" and the Inspectors, being enforcement agents of the Commission, can prefer charges in cases of willful pollution or call upon the Division's other technicians for confirmation of water damage beyond the scope of their measurements. The amount of waste control effected by these men immeasurably relieves the Stream Control Commission of more burdensome agendas then they now have.

The Coastal Waste Control section, headed by Captain Jack Hood, is under the supervision of the Division of Oysters, Water Bottoms and Seafoods. This section is doing an excellent job controlling wastes from bay and offshore oil installations. However, there is a dire need to expand this group to keep up with the growing number of installations in these areas.

To aid the Biologist in pinning down the nature or concentration of toxic substances, the Division Chemist performs all of the intricate tests which deal with water analysis. The methods and services contributed by this section are reported below:

CHEMISTRY SECTION

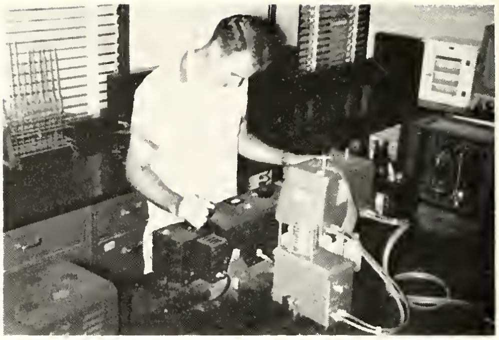
Charles D. Vernon

Chemist

Activities at the Water Pollution Control Laboratory located in Baton Rouge illustrates the point that many sciences are applied to water control work. To do its work, the laboratory requires the services of people with varied backgrounds in the field of biology, bacteriology, chemistry and limnology.

The laboratory performs functional activities devoted to chemical and biological analyses, evaluation of proposed discharges by industry, and collection of base line data.

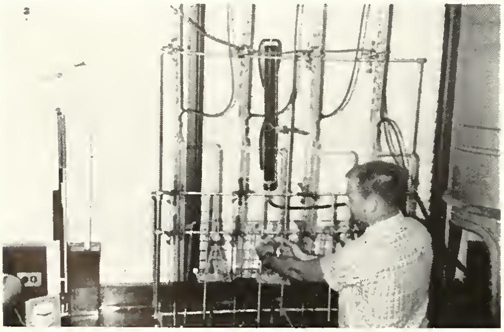
The chemical and biological activities are concerned with current or potential problems. Our field men with water testing equipment are instrumental in augmenting this phase of work. At the site of the problem they perform field analyses or take samples for more critical analyses in the Baton Rouge laboratory.

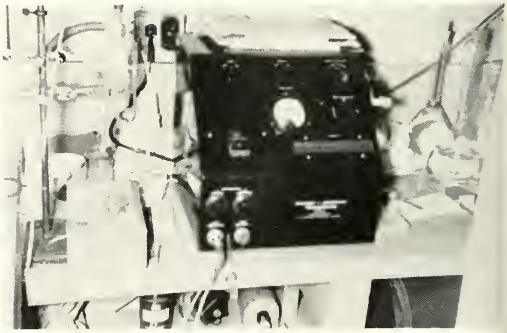

Assistant Chemist James S. Mathis checks the spectrographic equipment. An acetylene flame attachment on this Beckman DU Spectrophotometer permits a rapid qualitative or quantitative analysis for inorganic compounds in water. (Photo by Biglane)

The industries most likely to cause oxygen depletion in a stream are those producing large amounts of organic wastes which use the dissolved oxygen in the water.

Most of the industries producing heavy organic loads do not have facilities for analyzing their waste streams. At our laboratory in Baton Rouge we have excellent facilities for determining quantatively the amount of oxygen that will be lost from the receiving stream by the introduction of a given amount of organic waste. This determination, the biochemical oxygen demand test, requires incubation for five days at 20° C of a mixture of waste and water saturated with oxygen and seeded with bacteria. By knowing the amount of oxygen originally in the sample and the amount remaining after incubation, the oxygen demand of the waste can be calculated. This is the most important single test carried out on organic waste material at our laboratory. In the past two years we have helped several industries and municipalities clear up problems along this line. Some of the municipalities aided were Winnsboro, Lafayette, and Alexandria. Industries helped were: meat packers, paper producers, sugar mills, food canners and pine products companies.

Many signs point to the continued rapid expansion of the chemical industries in the State of Louisiana. Industry's need for process water of acceptable quality will grow, as will its need for stream flow to receive its residual waste. The problem is already important for drinking water supplies. It has been estimated that for U. S. communities of 25,000 population and over using surface water, 84 of the sources (serving 67% of this population) have received some sewage or industrial wastes. The need for protection of our fisheries resources is being impressed with ever-increasing vigor upon


Chemist Charles D. Vernon adjusts a flask on the liquid-liquid extraction unit. This vital piece of laboratory equipment allows for a very accurate determination of amounts of oil in water.


The Polorograph, an instrument used for the detection of quantitative amounts of gases in water, is shown in the Division's constant temperature and constant humidity room.

industry. Water quality requirements for industrial, agricultural, and recreational uses of water must be expressed more forcefully in the future as utilization of our water resource becomes more complete.

In the light of expanding demands on our waterways, it is timely to inquire into the validity of correct procedures for estimating the rate at which new waste materials may be assimilated. This matter is important because recent investigations suggest that at least a number of such substances respond slowly to biological action. A logical interpretation would be that these wastes have highly specialized requirements for seed, or that they are toxic to normal seed organisms. However, following prolonged exposure, microorganisms in the stream may become adapted to metabolizing these materials. Further study of present methods would be desirable for predicting the rate at which a stream may assimilate an organic waste of non-sewage-like character.

A frequently occuring situation involving utility of current procedures is the following:

Given: A chemical industry desires to locate a plant on a stream used for sport fishing and as a source of drinking water. The Company is able to supply information on the composition and maximum flow of residual plant waste.

Problem: Can a reliable decision be made on the ability of the stream to assimilate this waste without adversely affecting its present uses or potential uses in the future? If so, what type and degree of treatment is necessary?

Results: If this problem can be solved our current procedures are adequate. However, the present state of knowledge does not always permit those concerned to reach completely satisfactory decisions that will allocate the stream's resources in an equitable manner.

New knowledge is required to enable industry to use a stream, without damaging downstream water uses. One such approach is to use the B. O. D. and C. O. D. tests which characterize a waste's demand on the dissolved oxygen resources of the stream. Routine bioassay with aquatic organisms provides important information on toxic properties of a waste or specific chemical. This procedure gives information on the concentration of the waste or chemical that will kill 50% of test organisms in a specified time, usually 24, 48, or 96 hours. The results are expressed as a 48-hour TL_m, i. e., the concentration of the waste which kills half the test animals in 48 hours. This knowledge is of value in recommending the maximum concentration of the waste or chemical that a healthy fish community in a stream may be expected to tolerate. The recommendation usually involves the use of an "application factor," which is applied to the TL_m to allow for several important conditions not evaluated in the bioassay procedure. Among such conditions are (1) the effects of repeated exposures to low concentration of the waste over long periods of time, (2) the toxic effect of the waste on fish food organisms, and (3) the dynamic flow characteristics of the waste and the receiving stream. It is apparent that an unsound interpretation of available data may provide inadequate protection for fish, or it may place a burden of excessive treatment on an industry. If pollutional effects are observed some treatment obviously would be required. The affected industry would then be interested in some form of treatment prior to discharge.

The collection of base line data is not new to the laboratory. For example, streams receiving raw sugar mill wastes have for many years been under surveillance during the grinding season. This information has been valuable in predicting future conditions of the streams and thus perhaps many fish kills due to depleted oxygen have been prevented.

The United States Geological Survey analyzes a few of our streams for water quality and these reports are available to state agencies for information purposes. It is felt that this is a good program but does not go far enough. Therefore, we plan to augment the federal program in order that a better picture may be had of our state water situation.

Our fieldmen will be used to collect samples for this program and it is felt that with the information obtained we will be in a better position to give industry and the public more reliable predictions of effects of various residual wastes on a stream.

In line with this program is a study currently in progress on the effect of Baton Rouge and local industries on the Mississippi River. One question we would like to answer is how far downstream can material introduced at Baton Rouge affect the river? This will encompass a study of hydrometric data, sewage volumes and industrial volumes.

Public Law 660—The Federal Water Pollution Control Act.

In July, 1956, the President signed Senate Bill 890 which became known as Public Law 660, The Federal Water Pollution Control Act. This law superceded and strengthened the old Act, Public Law 845.

Louisiana has materially benefited from the provisions of this Act as can be seen from the step by step analysis below.

1. *Assistance to the states in research, investigation, training and information.*

So as to keep abreast of new and better methods of evaluating the effects of certain wastes in the streams, the Division biologists and chemists are encouraged to take special short courses at the U. S. Public Health Service, Robert A. Taft Sanitary Engineering Center in Cincinnati, Ohio. To date, six employees have taken advantage of this valuable opportunity. New and faster analytical and survey techniques were learned at this institution resulting in a better understanding of streams needs and capacities.

2. *Grants for Water Pollution Control Programs*

With the help of Mr. John Trygg, Director, Division of Public Health Engineering, Louisiana Department of Health, the Division prepared the "Louisiana State Water Pollution Control Plan" in December, 1956. This plan outlined the projected use of federal moneys to be alloted to Louisiana over a period of two years. The state has received in part and will ultimately receive over $80,000 in grants to extend and strengthen the water pollution control program. Matching funds were furnished by the Division of Water Pollution Control. A few technical personnel and Waste Disposal Inspectors were added in areas of the state needing immediate attention to stream problems and valuable laboratory equipment was purchased. The full benefits of this program will not be felt until the next biennium because of the scarcity of scientists needed to fill key positions. It is sincerely hoped that the Congress sees fit to continue these grants in 1958 and 1959.

3. *Grants for the Construction of Sewage Treatment Plants*

This section of the Act is being ably handled by the Louisiana State Department of Health. Louisiana's share of these grants amounted to nearly $2,000,000 for the two year period. This money is given to municipalities for the construction of sewage treatment plants in the amount of 30 percent of the total cost of the construction or $250,000, whichever is the smaller. Just how successful these grants have been in stimulating the construction of sewage treatment plants over the state was shown when an inquiry revealed that applications for the total amount have been received by the Health Department and, in fact, applications totaling an additional $500,000 has been received in the event the Congress moves to continue the program.

4. *Enforcement measures against pollution of interstate waters.*

Corney Lake Hearing

In January, 1957, a Hearing Board appointed by the Surgeon General, U. S. Department of Health, Education, and Welfare presided over the first interstate pollution action ever to be brought between two states in accordance with

Public Law 845 (since amended by the present Public Law 660). For more than 16 years the citizens in the Corney Lake and Bayou D'Arbonne watershed had been aggrieved by the discharge of oil field brines from the State of Arkansas. This watershed had been rendered virtually useless for fishing, recreation, or as a source of domestic water supply by the presence of these wastes.

Appointed to this Board were the following named persons: Chester S. Wilson, Chairman, Conservation Commission, State of Minnesota; K. E. Biglane, Executive Secretary, Louisiana Stream Control Commission and Chief, Division of Water Pollution Control, Louisiana Wildlife and Fisheries Commission; H. C. Jackson, U. S. Department of Commerce; Glen T. Kellogg, Technical Secretary, Arkansas Water Pollution Control Commission, and Blucher A. Poole, Director, Indiana State Board of Health, Chief Engineer and Technical Secretary of Indiana Stream Control Board.

The Board convened in Homer, Louisiana, on January 16, 1957, and heard testimony from thirty or more citizens plus catalogued data developed by engineers, chemists, biologists, and other technical personnel representing the U. S. Public Health Service, the Louisiana Wildlife and Fisheries Commission, and the Arkansas Water Pollution Control Commission. After all testimony was completed the Board then submitted their findings of facts, conclusions, and recommendations to the Surgeon General. Shortly thereafter, the Surgeon General issued cease and desist orders to the offending oil operators in Arkansas and as a result, all oil field wastes were removed from this watershed.

Sources of Water Pollution in Louisiana:

As a result of the concentrated efforts of the Division of Water Pollution Control and the Stream Control Commission water pollution from the forty-odd cane grinding mills in the State was virtually eliminated during this biennium. Conditions for the better had been steadily increasing over the past number of years and in 1957, less than a half-dozen complaints were received, and more than half of these few were not traced directly to sugar mill operations. The State experienced a very rainy season during cane grinding operations and as a result the streams were bank full in those areas. This provided tremendous amounts of dilution waters for the mill wastes, but other problems brought on by the wet season were encountered. For one thing, run off water from the swamps and lowlands threatened to bring about natural pollution problems experienced earlier in the year before and immediately after Hurricane Audrey. Stagnant swamp waters, decaying vegetation, and other type of debris were swept into our streams and imposed oxygen demand loads equal to or exceeding that of sugar mill wastes. Earlier in the year when this phenomenon was noted, forecasts of natural fish kills were predicted by the Division. These forecasts proved to be true in every area mentioned. The main factor that prevented gross reoccurrances of this natural phenomenon during the cane season was lower water temperatures. This allowed the stream to absorb and maintain higher oxygen concentrations than it did in the warmer spring and summer months. Nonetheless, these "runoff loads" did not enhance the ability of the stream to assimulate cane wastes.

The sugar cane crop in 1957, was reported to be the best in fifty years in terms of cane produced. This fact necessitated a longer grinding season and overloading in some of the mills. Along with this the mill operators experienced trouble with muddy cane and toward the end of the season, frost hit the crop and caused a lot of cane to be soured and subsequently lost.

As was mentioned earlier, the State agencies charged with water pollution control have worked very hard on stream pollution arising from cane wastes. However, special recognition of these accomplishments belongs to many of the factory managements, for without their active cooperation with the State group, this problem could still be very serious. For this reason, in 1956, the Division nominated the Sugar Cane grinding group in a national survey of industries showing the most improvement in waste treatment. This nomination was more than justified by the continuing improvements demonstrated in 1957, and it is hoped that 1958 will see an all time low in incidences of sugar mill pollution.

Sugar Mills

R. A. LaFleur

Assistant Chief

The active efforts taken by the management of raw sugar factories in the past several years in a most heartening example of the accomplishments possible in the abatement of stream pollution from industrial sources. Through the cooperative efforts of the managements of the many sugar factories and the Division of Water Pollution Control, it can be said that stream pollution from sugar factory waste discharges now virtually belongs to the ages.

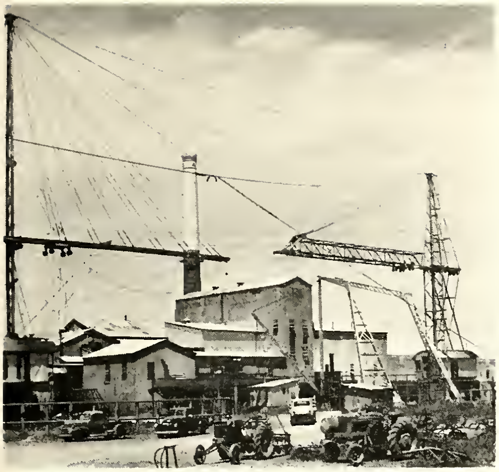
For the past several years during grinding season the majority of the division personnel have devoted their entire attention to sugar factory discharges and the receiving streams. The corrections and improvements such as machinery overhaul, installation of recent mechanical improvements, cleaner housekeeping, and adequate impoundments for waste that is of necessity retained—these things have all contributed heavily to improvement of quality of waste water discharge.

Listed below are bio-chemical oxygen demand values recorded on a weekly basis for the past four years on one factory. This factory is but one of many whose waste effluent has shown significant and remarkable improvement.

Date (1954)	*BOD	Date (1955)	*BOD	Date (1956)	*BOD	Date (1957)	*BOD
10-20	184.0	10-26	24.6	10-30	69.0	10-29	39.6
10-25	158.0	10-31	100.6	11-13	46.8	11-5	+60.0
11-4	258.0	11-7	42.0	11-20	51.4	11-13	44.0
11-15	391.0	11-17	51.0	11-29	+150.0	11-18	88.2
11-23	294.0	11-30	37.2	12-6	65.7	11-26	22.8
11-30	276.0	11-9	28.7	12-13	+150.0	12-5	148.5
12-9	259.0	12-14	20.0			12-11	207.0

*BOD—Biochemical Oxygen Demand—expressed in parts per million.

The grinding seasons of the years 1956 and 1957 presented two contrasting situations as a result of the prevailing weather conditions. In the 1956 grinding seasons, little if any rainfall was recorded, streams were at a near all time low, yet due to efficient factory operation and a good quality of effluent discharge very little stream pollution resulted. During the 1957 grinding heavy rainfall was recorded during the entire season. These extremely adverse weather conditions imposed a heavy burden on the sugar factories in having to process cane that was either and/or muddy, frozen and sour. As a result, the quality of effluent was, in many cases comparatively worse, yet because of the greater stream flow and hence greater dilution, very little stream contamination was observed. It must be remembered however, that had the many improvements in waste water handling and treatment



A typical Louisiana Sugar Cane Mill. Typical in appearance but the Evan-Hall Sugar Mill in Donaldsonville, Louisiana has an 1800 acre impounding basin in which it pours all of its wastes. The farsighted management at this mill has insured itself against ever causing pollution from grinding operations.

not been an accomplished fact, it would be safe to say that gross stream pollution would have been the rule rather than the exception.

Oil Field Wastes:

The oil producing industry in the State is being faced with more and more pollution problems each year and much concern has been expressed by this and other agencies interested in municipal water supplies, wildlife, recreation, and water for agriculture. Instances of accidental oil spillage to streams, pipe line breaks, illegal discharge of drilling muds, badly maintained leases and oil storage facilities and general negligence did not decrease during the biennium. More court actions against this one industry were initiated in 1956 and 1957 than any other industrial group in the State. The situation would be even worse were it not for active concern by many individuals connected with the industry. This, plus the fact that the Division has nearly doubled its field enforcement personnel since 1956. On many occasions the Division Chief and his associates were called upon to speak before large groups of drilling contractors, oil lessees and lessors, oil carrier representatives, and oil field workers in general, to outline the problems and suggest corrective measures. On every speaking occasion the Division's representatives were treated cordially and their complaints and suggestions were received with an air of constructive criticism. The value of these personal contacts were revealed when many companies began large scale clean up operations and conducted on-the-job pollution prevention training programs. But this is a vast industry with operations in 58 of the State's 64 parishes. In fact, in terms of mineral value, liquid or gaseous petroleum products head the list in 51 of the 58 petroleum producing parishes. Admittedly, this type of mineral production was concentrated (63% of total value) in the top ten parishes but, according to the Department of Conservation, at the end of 1956 there were 756 oil and/or gas fields with over 24,000 wells capable of producing oil or gas. Investigations of these areas alone nearly consume the full time activities of most of the Division's Waste Disposal Inspectors.

The stream problems from this industry vary with the state location. In North and Central Louisiana, oil field brines during the low stream flow months and oil wastage are the two most common complaints. Legislative laws regulating the seasonal discharge of brines have curtailed these wastes in the Southwest Louisiana agricultural areas but drilling compounds of an acid or alkaline nature sometime create hazards to fish, wild game, and cattle. The bay and coastal areas suffer from illegal discharge of oil emulsion base drilling muds and oil spillages.

As mentioned before, the Division has received a tremendous enforcement assist from many members of this industry and it is this segment which will continuously better their housekeeping and disposal methods. It is unfortunate that the industry as a whole must be constantly remanded because of the poor operations of a significant number of their membership.

The following plans are now in operation to halt present and future damage to State streams from oil producing operations.

1. Increased enforcement of the rules governing the drilling for, production of and transportation of petroleum products.
2. Encouragement of meetings with representatives of the Stream Control Commission and the industry managements to seek active cooperation in abatement programs statewide.
3. Encouragement of meetings between field personnel and industry management to stimulate abatement programs on a local level.
4. Increase enforcement staff in coastal areas.
5. Stepped-up research by this Division on pollution abatement problems connected with the drilling for and production of oil.
6. Encouragement of more research by the oil industry on their own problems.

Sand and Gravel Mining Operations:

This industry poses a serious problem to waste control personnel for several reasons. First, by washing sand or gravel most of the operators are not adding anything to the stream which was not already there and so they create a physical, rather than a chemical quality change in the stream and its waters. It is true that sand and gravel washings may alter the stream channel by the deposition of sediments. These materials can create underwater, shifting "sandy deserts" and seriously curtail the population of bottom form organisms normally used by fishes for food. Sediments can also cover fish spawning nests and it is generally observed that game fishes cannot be caught by tackle in highly turbid waters.

In the State, there are over 100 operators known to be mining for sand or gravel as a full time occupation. The number of operators that maintain small portable rigs and operate just on occasion is unknown. Their problems vary with the location of the dredging operation. If they are on land, following an old stream bed, or on a natural deposit of these materials, their wash water may be held in a sizable impoundment. Since rainfall and evaporation rates just about balance each other in Louisiana, these impoundments are subject to overflow, levees are in danger of being washed out by heavy rainfall or give away by the very temporariness of their design. In any event, these highly turbid impounded waters generally find their way to a near by stream, lake, or river and pollution occurs.

If the mining operations are in the stream itself, their problems increase. If there is not sufficient or available lowlands near the rig in which to divert their wash water, then the stream receives the full brunt of this silt laden water. Sometimes the suction hose is deliberately directed to undermine part of the stream bank and as the bank sections tumble into the water, clays and other soils having a fine particulate size are carried in. This type of silt causes a milky color in the water since it rarely precipitates until it reaches the Gulf or has traveled many miles downstream. Bank cutting is in

The Division's research craft Bluegill II. This boat was designed by the staff's technical personnel and is a modern "Floating Laboratory". Dr. Richard Gregg prepares to drop the sampler at a sampling point.

direct violation of our laws and is stopped immediately upon detection.

There are several steps the Division Inspectors may take to curtail this type of water damage. First, they have the operator redirect his wash water stream to available lowland near the rig. This allows the water to lose most of its heavier sediments before returning to the stream. They encourage reuse of wash water whenever possible.

If, in the Inspector's opinion, the levees surrounding the impounded wash water appears weak or inadequate, the operator is made to strengthen and reinforce these walls. Finally, the miner is encouraged to move his whole operation to another location if everything else fails.

At the present time, the Division is attempting to draft a set of standards and regulations applicable to this industry. When completed they will be submitted to the Stream Control Commission at a public hearing. Any such regulations must be reasonable and workable before adoption and therefore considerable research must be done. Chemical precipitation of silt, much in the same manner used by water treatment works, is being studied. It has already been observed that this method works best when the water receives a minimum of agitation by wind, rain, or an inflow stream.

With the stepped up highway program across the state, sand and gravel mining operations continue to expand. The Division expects to be prepared for these events as they relate to water damage.

Miscellaneous Sources of Pollution:

After checking the areas occupied by over 24,000 oil and/or gas wells, over 40 sugar mills, and over 100 gravel mining operations, the Division personnel must also be aware of water damage which may be caused by chemical plants, food processing plants, oil and gas refineries, pine products plants, sawmills, agricultural insecticides, timber topping operations, slaughter houses, rendering plants, drainage projects, and paper mills.

A considerable amount of time has been spend by the Division Engineer in eliminating pollution caused by potato wastes in the vicinity of Lafayette. A nearby slaughter house added to the damage of the stream carrying the above materials. Excellent cooperation has been received from the managements of these plants and with the addition of larger impoundments, stricter housekeeping, hauling away of certain waste components, installation of screens and other solids eliminating equipment, the waste load to the waters in the Lafayette area has been significantly reduced.

Inspection of certain oil refineries in the state showed some of them to be in great need of general cleanup. Leaking oil lines and storage tanks, inefficient operation of oil separators, sludge banks in discharge canals, oil laden solids in final effluents, taste and odor components in discharges located above domestic water supplies, and haphazard techniques in petroleum products transfer were the most common complaints to the managements. Here again, excellent cooperation from most of the refinery personnel resulted in the abatement of pollution from the above named sources.

A check into some chemical plants located along the Mississippi River showed some of them to have inadequate collecting systems for plant drainage and batch spills. As these items were corrected, safety monitoring devices were ordered installed on certain waste streams so that an alarm could be given in the event of an accidental spillage.

A plan submitted by the Olin-Mathieson Paper Mill, located in West Monroe, Louisiana, to treat their wastes was approved by the Stream Control Commission. After a proposed expansion in production this mill will discharge nearly 1,300,000 gallons of waste water per hour. Their treatment plans include two 15 acre primary settling basins to be followed by two or more 150 acre oxidation ponds. Pilot plant studies by technical personnel of this mill indicate a reduction in the Biochemical Oxygen Demand from 300 parts per million to 100 parts per million or less. Upon completion of these treatment facilities, the Ouachita River will have been relieved of a significant waste load.

A major step in further clearing the Ouachita River of polluting materials was taken by the State of Arkansas when it detailed its entire water pollution control staff to survey the sources of contamination to this stream. It was also revealed that the majority of the Grant Moneys received by this state under Public Law 660, together with a sizable legislative appropriation was spent in contracting services, adding technical personnel, and purchasing necessary survey equipment to complete this project. Two public hearings were held by the Arkansas State Water Pollution Control Commission in 1957 involving industries contributing to the pollution of the Ouachita River. A third hearing will be held in 1958, and Louisiana will be more than interested to see the final outcome of these hearings for two reasons. First, this is an interstate stream and it is polluted as it comes into Northeastern Louisiana. Secondly, the City of Monroe desires to use the Oua-

Aboard the Bluegill II Chemist Charles Vernon (kneeling) adjusts the instrument for the detection of dissolved ids in the Mississippi River. Dr. Gregg makes adjustments on the boom and water sampler.

chita as a source of domestic water since its present source has become inadequate to serve her expanding populations. The Division and the Stream Control Commission will continue to press for water of acceptable quality as it comes into the state.

Present Surveys and Future Plans for the Division:

A full scale investigation of the Mississippi River in the vicinity of Baton Rouge was launched near the end of the biennium. Such a survey had been in the planning stage for quite some time and with the addition of a 30 foot, steel research craft the last obstacle was overcome. This boat is completely equipped to do comprehensive, on-the-spot chemical analysis of this tremendous river. It is also rigged to collect biological data and a full time crew, including a chemist and a biologist, has been assigned to collect weekly samples. This survey is believed to be most timely in the light of the tremendous industrial complex that has materialized between Baton Rouge and New Orleans. According to the State Department of Health, there are eleven parishes below East Baton Rouge Parish that depend entirely or in part on domestic water supplies from this river. It is also being used to supply agricultural irrigation needs and process water by the majority of the industries located near its levees. The Mississippi River supports a tremendous commercial fishing industry as well as being the longest aqua highway in the United States. The survey being carried on by the Division is deemed most timely in determining just how much more of a waste load this tremendous waterway can handle.

The initiation of a basic data collection survey to assay water quality in streams all over the state will begin shortly. The State Geological Survey, the Department of Public Works, and the United States Geological Survey are making excellent data collections on ground waters and surface waters in many areas of the state. The Division hopes to help complete the picture as it relates to water quality in Louisiana.

The Division's Chemistry Section is considering the necessary equipment to determine radiation levels in our surface waters. In the light of industrial uses of radioisotopes and other nuclear materials this type of survey is also deemed timely.

Incidental researches as related to water pollution from insecticides, gravel mining operations, oil field wastes, sugar mills, and food processing plants will be expanded during the coming biennium.

FISH AND GAME DIVISION

JOHN S. CAMPBELL
Chief

FRED L. MYERS
Assistant Chief

TED B. FORD
Office Chief

JOHN CAMPBELL

The keynote for activities of this division these past two years has been service to and cooperation with the public in order to stimulate and further their interest in the conservation of Louisiana's fish and game resources. Conservation is the wise use of these and other resources available to us. Controlling fish or game populations to keep them in balance with their habitat or range is one example. The sportsman is the best person to do this and, in many instances, hunters and fishermen in large numbers are the only ones who can effectively accomplish this control. The absence of this management tool when needed will permit unbalanced fish populations to develop, overpopulations of game with damaged or depleted range, stunted and less vigorous game or fish populations due to inadequate food, and a high degree of susceptibility to and intensity of disease and parasitism. The end result is a net loss across the board, being a waste of resources rather than conservation.

The objectives of good conservation can be met provided the people of Louisiana are willing to share the responsibilities. For instance, the professionally trained fish and game technicians can recommend suitable and desirable management programs for different species of animals to meet the needs of the various types of habitat in Louisiana. However, it is the people who must utilize these products of soil and water, and they are the ones who reap and enjoy the associated benefits and pleasures. Accordingly, if good management programs for these resources are desired, then the people must ask for them. Regardless of how much technicians of this division may want to provide these programs, they are ineffective in meeting the needs without public support and unless these responsibilities are shared by all within the state.

This can be further illustrated differently. The probability is great that there are no areas in the state today which are the same as they were thirty years ago. The ecology (or environment) of this state is continuously changing—much of it is due to man's activities. Some of these activities can be modified to the advantage of all interests. The need is great for having trained technicians who are continuously working and studying these changes so that flexible fish and game programs can be designed to keep abreast of these situations and to retard undesirable changes for maximum benefits. To meet these needs, research, development, and management programs are essential for a balanced fish and game economy. It is only through alert and dynamic programs such as these that man's fish and game needs can be met by the implementation of sound, well-founded programs with adequate funds and trained personnel.

In surveying the fish and wildlife needs of Louisiana, it becomes evident that more fisheries research is essential to be able to adequately manage and improve all the fishing waters of this state to the best advantage. This program has been moving ahead, although curtailed by inadequate funds to provide enough trained technicians, other personnel, and equipment to do the job. Unfortunately, there are many public waters in Louisiana with no public access. There is an immediate need for securing and developing public access sites to public fishing waters, where a pier and boat launching facilities are provided. Based on present knowledge of surveys, there are a number of lakes within the state which need rehabilitation, including subsequent population studies and creel censuses. Consideration should be given to the acquisition of land for fish and waterfowl developments to meet future needs of the Louisiana sportsmen. These aims, to mention some, will indicate that the objectives of this division and its personnel are high, and every effort will be made to achieve these goals.

Basic game research was initiated earlier than fisheries research in this state. Accordingly, more is generally known about management of game species in the different types of areas. However, even in this field, there is a need for continuing research, in some instances, at a more refined level. Knowledge in any field of work is a tool if properly utilized. With this continuing research, there are needs for adequately managing existing areas, as well as, developing additional areas to derive the maximum benefits available through game work. The profits derived from such capital investments mentioned above will be shared by the stockholders of this organization, the sportsmen who buy licenses.

The primary source of money for conducting these fish and game research, development, and management programs is derived from Pittman-Robertson and Dingell-Johnson Federal Aid Funds. Congress recognized the need for establishing and continuing sound fish and game programs in all the states. Accordingly, the above named legislation was passed and this provided for federal excise taxes on all types of hunting and sport fishing equipment and supplies. These funds, derived from the sportsmen, are pro-rated separately to the states, generally on the basis of area and percentage of fishing or hunting licenses sold, provided the states match

TED FORD

these funds on a 3 to 1 basis ($300.00 of federal aid funds to $100.00 of state funds). An increase of license sales in Louisiana should provide more funds for carrying out more extensive programs. The administration of these funds provides for the expenditure of this money on sound biological projects relating to fish or game. Therefore, trained technicians are required to develop and conduct these research, development, and management programs in the interest of providing maximum fish and game yields under the existing conditions for the sportsmen of this state.

In addition to performing duties mentioned above and elsewhere in this report, personnel of this division have ably represented the Commission in many activities over the state. They have appreciated having the opportunities of working with sportsmen and to explain fish and wildlife management problems to the various groups of interested people. Wildlife exhibits have been arranged at some of the annual fairs, which permitted the first view for many people of some living wild animals native to Louisiana. A number of requests for technical assistance and of a general wildlife nature have been satisfactorily acknowledged. Several wildlife complaints have been investigated and recommendations were furnished.

Hyacinth control and aquatic weed research has progressed. Extensive areas of hyacinth infested waters have been cleared and others reduced. Continuation of this program will provide more fishing waters and areas for waterfowls, as well as, improve navigation. In view of the fact that many other aquatic plants create problems in Louisiana waters, research is being conducted to find effective chemicals that can be applied economically without destroying the fish.

Funds were somewhat reduced during the past two years. However, all basic programs have been maintained and some phases of these programs were expanded. Each section of the division presents more fully coverage of its activities during this period on the following pages.

RIVER BASIN STUDIES

T. B. FORD

Supervisor

The program of wetlands habitat preservation has been continued during the past two years of 1956-57 and 1957-58. Activities of many various groups associated with wetland areas continued at a high level of performance. If some of these groups were not actually in the process of changing the ecology of these marsh, swamp or stream bottom areas through flood control, drainage, or navigation projects, then it would appear as though the drawing board plans had not been completed, business or some particular arm of our government had not made the funds available, or all available equipment and personnel were working. It would be just as foolish to say that all of these developments or projects are not important, completely justifiable, and badly needed, as it would be to say that they are, for each one depends on that particular situation and its individual credits and debits. Blanket coverage is the procedure utilized to conceal activities and is comparable to a smokescreen.

It should be clearly stated now and understood by all interested people or groups of interested people that this Commission stands firmly behind a policy of developments and improvements for the citizens of this state and country. Operating under this policy for the past five to eight years, the personnel associated with this phase of the Commission's program have made every effort physically possible to point out potential effects of many types of water control projects to all interested people and agencies. This fundamental approach is based on the fact that if the people of an area understand the losses and gains associated with any change, they would be more able to better determine whether they want to live with and pay for the changes. Unfortunately, some observations would indicate that many people do not have the ability to recognize or understand the difference between short-term changes and long-term changes. This same principle appears to hold true for benefits associated with projects. These facts of life are unfortunate because generally the people of an area or of the country or its subdivisions are called upon to pay for the cost of the changes and then must live with them. Recently, it has been in this latter stage that this Commission has been brought into the picture. Why? Some people have recognized that the fish or wildlife populations of an area have changed over a period of several years, frequently decreasing in numbers and kinds of desirable species. To restore these desirable wildlife populations is often costly or impossible since their habitat has been changed, probably with public funds. Perhaps the reclaimed land is now in cultivation producing crops or animals on which supplies have far exceeded the demand yet requiring government support for some of our people to survive in these fields. This example may be applied to many other interests. If such a situation should exist, then it would appear as though public funds are being spent for the "cause" and the "effect". Accordingly, great savings in wetlands and public funds could be made if all factors are carefully considered and evaluated by the influenced people before the above mentioned changes in land and water are wrought.

This Commission is further concerned because it believes that there must be a balance in land and water uses. Such a balance will provide for fish and wildlife resources and will meet the sport, recreational and commercial needs of the people of this State. The benefits associated with these products of land and water are great! Tangible and intangible values on all aspects of these resources make it difficult, however, to place a true dollar value on all these resources when compared to the evaluation of an automobile, army tank, apple or pig. It is this aspect of the problem that makes it difficult for your fish and wildlife representatives

FRED MYERS

to present more accurate information bearing on the value of proposed projects.

It has been suggested many times by those who have been interested in initiating wetland devastating projects that the fish and wildlife interests should go out on their own and get the Legislature or Congress to provide the money to minimize the losses to fish and wildlife habitat or resources associated with the proposed project or for enhancement purposes. This may be a practical approach, but it is interesting to note that in most cases nothing or inexpensive developments would be the only thing necessary to provide for fish and wildlife, without this new "development".

Ownership and title to all fish and wildlife resources found in the state is declared to be in the State of Louisiana in its soverign capacity as keeper for the people until legally taken under the regulations administered by this Commission, when ownership reverts to the individual. As custodian of these natural resources, the Commission must do all that is possible to protect, conserve, and replenish the fish and wildlife resources for the people of Louisiana. These efforts are being made through the many phases of its program, one of which is land acquisition and development. However, it should be pointed out that this is expensive, time-consuming, and limited to relatively small areas. In other words, while a small area of several thousand acres is being developed for fish and wildlife, a desirable area (five, ten or more times larger in size), requiring few, if any, developments, is being adversely affected by some type of water control project. Accordingly, it becomes obvious that this is a losing battle and the needs become evident. If the various public and private agencies are actually working in the interest of the citizens of this state and country, then there will be a basis for cooperation, coordination, and compromise in the development of our land and water resources. This should result in multiple purpose developments, with the inclusion of and provisions for means to safeguard the soil, water, and products thereof. Perhaps of far greater importance, this should result in the elimination of "special interests" projects to the detriment of other recognized uses or that the responsibility of providing safeguards for other recognized uses should be borne by the "special interests". To meet these needs, a positive, dynamic program must be adopted and a well trained staff of technicians must be developed to study the problems, work with associated agencies, and present the findings in their true perspective to the people so that able decisions can be made.

In the past two years, efforts have been made to present fish and wildlife resource values in connection with several proposed projects and to present some of the problems to interested groups. It should be understood that this is sometimes difficult, especially in those areas where it is recognized by others that the proposed project will probably have detrimental effects on these important resources. Some champions of such projects have made efforts to have material presented which would create somewhat biased or prejudiced views covering aspects of fish and wildlife resources so that fundamental values might be lost or discounted. In the face of an apparent unanimous support for a project, anyone would dislike having to present material that might seem contrary to all other views. It has been necessary to do this, in some instances, in the interest of fish and wildlife resources. Through this and other means, it is felt that these valuable resources will receive the attention and consideration that is needed from the people, if they are to continue enjoying the harvest.

In 1956, a project of immense proportions began to move. It is known as the Mississippi River-Gulf Outlet Navigation Project or, locally, as the New Orleans Tidewater Channel. Since most of the material relative to this project had been considered and studied several years prior to this with fish and wildlife resources receiving little if any consideration, efforts were made by this Commission to bring this to the attention of Congress so that a biological study could be initiated in time to furnish recommendations, where and when needed, to the planning and contracting agency for modifications of alignment, spoil deposition, and other basic factors for preserving irreplaceable wildlife and fisheries habitat. These efforts were to no avail. Early in 1957, a number of sportsmen, commercial seafoods fishermen, related organizations, and some industries became concerned about the possible effects of this project and requested that the Commission make recommendations and take action to preserve the fish and wildlife resources in the area influenced by the project. Accordingly, a statement was developed in which definite recommendations for missing important parts of the marshes and confining the channel to apparently more stable areas were made, based on existing knowledge of the project area. Included also, were reasons for these recommendations and values for annual crops of fish and wildlife resources, and an indication of the recreational use of the area. The Commission directed that this statement, its first official comments on the project, be sent to the Louisiana Congressional Delegation, other public leaders, and all interested public and private agencies. Apparently, considerable interest has been stimulated on local and national levels. A spirit of cooperation and willingness to study the problems and develop means for counterbalancing some of the effects is evident. The Fish and Wildlife Service in cooperation with this Commission is actively working on plans for studying the area in conjunction with developments by the planning agency, The Corps of Engineers. Due to the many problems involved and the area of influence, these studies will require several years, considerable money, and the close cooperation of the interested agencies. It is believed that this will be forthcoming.

In the spring of 1957, another big, far-reaching proposed project was dusted off and brought up again. This was the Freshwater Bayou and Vicinity Navigation Project. Personnel of the Commission presented material relative to the fish and wildlife resources of this area. After these values were indicated as being high, problems relative to the geology of the area, which had been studied, were pointed out. Recommendations for an alternate route through Cutoff Canal, Vermilion Bay, and Southwest Pass were made from the standpoint of wildlife and the geological trends of the area. Presently, The Corps of Engineers is completing its survey report of this proposed project for presentation to Congress.

The two projects referred to above could have extensive, long-term undesirable effects on the fish and wildlife resources of Louisiana. These and similar projects originate with the local people. Certainly, few of us question whether or not such projects will do what they are constructed to do, provided there are ample construction and maintenance funds. However, a number of people do question whether it is advisable to have the projects and all the associated undesirable effects also. It is up to the local people to see that each project is carefully evaluated and the evidence presented to them in turn, so that they can determine whether or not they want to live with it.

There are a number of other activites which are rapidly changing the ecology of the Louisiana wetlands. Failure to recognize them would be unfair in acknowledging the habitat problems in the wetland areas. Oil, gas, mineral, and associated developments and operations have resulted in a number of losses to fish and wildlife habitat and resources. Balances in nature, brought about gradually with an adjutment of plant and animal populations, have been subjected to rapid changes as a result of salt water intrusion, siltation, rapid fluctuations of water salinities, changes of currents, and rapid fluctuations of water levels. These effects have resulted from the many canals and slips promiscuously constructed with little or no regard for existing conditions. Frequently, undesirable effects could have been prevented if more than casual consideration had been given to the access problem, and a slightly less direct route were taken. In turn, some of these undesirable effects have resulted in claims against, as well as, monetary losses for the operators. It is felt that many of these problems and losses could have been prevented if the operators had requested assistance from technical personnel of this Commission prior to initiating their projects. Certainly, the losses to wildlife and fishery resources could have been decreased.

The recently inaugurated Soil Bank Program provides for land and water improvements for fish and wildlife through the Conservation Reserve. Practices for Louisiana were developed and coordinated with the Soil Conservation Service as administrators of this phase of the program under the A.C.P. Excellent opportunties are available to landowners, who may be interested in taking land out of production, for establishing wildlife food and cover plantings, waterfowl impoundments, or fish ponds. The Fish and Game Division will be pleased to furnish technical assistance to landowners who are interested in establishing any of these wildlife practices.

The small watersheds program provided for in Public Law 566, 83rd Congress, as amended, is getting under way in this state. There will be opportunitites for fish and wildlife developments in connection with these projects. Personnel of this division have been pleased to assist in reviewing and coordinating requirements for the fish and wildlife aspects of the projects with the Fish and Wildlife Service and the planning agency, the Soil Conservation Service. It seems appropriate to point out that each project should be carefully studied from all aspects for it is possible that high quality hardwood bottoms could be adversely affected by such a project. Accordingly, locally important squirrel or deer range could be lost in addition to the timber. Hence, careful evaluations and all needs must be considered before the final locations for structures are approved. In some instances, associated hardwood bottoms can be treated as green timber reservoirs, if excluded from the permanent pool, and these will be attractive to waterfowl and other wildlife without damaging the timber. The associated impoundments incorporated under the watershed management plans can have a number of applications for fish and wildlife in areas which need additional recreational opportunities. The provisions and inclusion for these types of management will depend upon the local people requiring that these needs are met.

Water control problems have required considerable time during this biennial period. In keeping with Commission policy, efforts have been made to cooperate with all interested agencies for minimizing or preventing losses to fish and wildlife. Personnel associated with this program have cooperated with the Gulf States Marine Fisheries Commission, the Fish and Wildlife Service, Louisiana Department of Public Works, The New Orleans Tidewater Channel Engineering Committee, The Corps of Engineers, and The Louisiana Wildlife Federation. In cooperation with the Corps of Engineers, two important areas are being developed and made available to the public for fishing, hunting, and other recreational purposes. These are the Bodcau Reservoir Wildlife Management Area in northwest Louisiana and the Bonnet Carre' Floodway west of New Orleans. More details relative to these developments will be found elsewhere in this Biennial Report.

Progress and achievements in this phase of work have been made. Credit for this must be given to Commission personnel, to some of the personnel of the above mentioned organizations, and to a number of outstanding citizens who have given generously of their time and services. It is recommended that a permanent staff be developed as a nuclear group working exclusively in this highly important program, for the needs of trained technicians will continue to be great if the Commission hopes to protect, conserve, and replenish the fish and wildlife resources for the people of Louisiana. Efforts to improve these services will be continued so that the needs can be more ably met.

Papers were presented at the 1956 meeting of the Southeastern Game and Fish Commissioners Conference, the 1958 Annual meeting of the Louisiana Soil Conservation District Supervisors, and the 1958 annual meeting of the Louisiana Wildlife Federation.

THE PUBLIC HUNTING PROGRAM

This phase of the Division's program is one of the most gratifying, for all sportsmen can easily recognize the efforts of Commission personnel in behalf of the public, while they cannot always appreciate the value of research. This is especially true for those sportsmen who do not have a place to hunt, since public hunting areas are available to them. A number of landowners, residents and non-residents, have cooperated with the Commission in making these areas available to the public, under the supervision of this agency.

Development of these areas is proceeding according to their needs as determined by technicians and according to the availability of funds. Efforts are being made to manage them whereby huntable populations of game species will be available. Hunting by the public is one effective management tool upon which the division technicians are relying to control the number of the various game species so as to keep them within habitat limits.

It is the Commission's policy to expand and continue this program in future years within the limits of available funds. In view of curtailed funds during the past two years, a division of operation of these areas has been affected within the Fish and Game Division. Some of these areas are still managed and developed with state funds, while others are managed and developed with federal funds by the Pittman-Robertson Section of this Division. These latter areas will be covered elsewhere in this Division's report under the Pittman-Robertson Section.

All of these areas have required considerable time and effort on the part of associated Commission personnel to make them function. Frequently, during hunting seasons on the various areas, this has meant long extra hours for several days at a time. Because these personnel have exhibited a keen interest in their work and recognized the needs for hunting opportunities, they have given freely of their time. The sportsmen's assistance and cooperation in furnishing kill data and the opportunity of examining his game taken from these and other areas for biological information is also appreciated. By these and other means, the wildlife technicians will be better able to make recommendations for managing the game populations in Louisiana.

PASS-A-LOUTRE PUBLIC SHOOTING GROUNDS

The program of public hunting on this area has been continuous since established on a large scale in 1954. It has been modified to meet changing conditions. During the past two seasons, 1,154 hunters have made a two day duck hunt from the nine maintained public hunter camps. A total of 2,482 ducks were killed during the 1956-1957 season, with a hunter success of two ducks per hunter per day. This compares favorably with statewide figures which indicate only one duck was taken for each hunter effort during the same season. During the 1957-58 season, 1,466 ducks were killed and though hunter success dropped to one and a half ducks per effort, this is still about thirty-five percent better than the 1.1 ducks/effort statewide.

The Pass-a-Loutre public hunting operation was conducted in a similar fashion as the two years prior to the current biennium. Hunters paid a $10.00 fee for the two day hunt during the past two seasons and were transported in Commission boats from Venice to the camps. Regulations were amended this past season, and a few non-resident hunters made the trip. All equipment, such as two-man duck boats, paddles, decoys, cooking utensils, butane stoves and heaters, fresh water and double bunks with mattresses and blankets, were furnished. The hunter furnished only his gun, food and linen.

At noon on the second day of hunting, the sportsmen were picked up at the camp and transported back to Venice. All ducks, geese and other game were checked by biologists to determine the hunter success and kill by species.

The gadwall (gray duck) is the duck most commonly killed at Pass-a-Loutre. This species usually constitutes approximately 40% of the total kill, with baldpate (widgeon) or green-wing teal running second at around 15-20%. Mallards generally rank fourth or fifth at approximately 10%. Only fifty blue and snow geese were taken during each of the past two years.

Hurricane Flossie, which occurred in September of 1956, the nutria and extremely high water during the growing seasons of the following year, were important factors in the reduction of desirable waterfowl habitat at Pass-a-Loutre over the past two seasons. Three-cornered grass (*Scirpus* spp.) has been almost non-existent on the mud flats which normally attract thousands of geese each year.

Perhaps, the nutria was the biggest contributor to this condition. Nutria populations reached high peaks and competed with other herbivorous animals for existing vegetation over many parts of the Pass-a-Loutre area. This regrettable aspect is nevertheless interesting, for approximately three or four years ago, efforts were made to control the aquatics by aerial spraying which was partially effective. Some ponds had become virtually covered with hyacinths and alligator weed, and others were threatened, while edges of the ponds were bordered with sawgrass, roseau cane, and other aquatics. Now it would be desirable to have some of that problem vegetation.

It appears as though this particular nutria population has decreased considerably in numbers during the early part of 1958. Lack of food was evident by seeing the bark eaten from willow trees as high as the nutria could reach. When man loses control of animal populations, lack of food, diseases, and/or parasitism will usually come to the rescue and reduce the population. In the meantime, the habitat is damaged or destroyed. This is a good example that the principle followed by some, "If a few are good, then a lot more are better", is not always correct.

Under ideal conditions, this area will recover. It is recommended and anticipated that water control structures be installed where needed. The Commission hopes that these conditions will prevail, so that better hunting opportunities will be available for this next season and future years. In keeping with the policy of this Commission, every effort is being made to provide hunting opportunities for the sportsmen of Louisiana.

LAFOURCHE PUBLIC SHOOTING AREA

Lafourche Public Shooting Area is located approximately ten (10) miles west of Rayville on Highway 80 in Richland Parish. Primary interest in this area is waterfowl shooting. The area is composed of 1,875 acres of bottom-land hardwoods. At one time this area was flooded naturally and held water for excellent waterfowl shooting. With the Lafourche drainage program, this area has not been capable of holding water.

With permission of the landowners on a long-term lease basis without fee the Louisiana Wildlife and Fisheries Commission is reflooding the area during the waterfowl season by means of water control structures. In 1955 the Commission blocked the spoil gaps on the west side by use of their D-7 dozer and American dragline. By doing this it was possible to flood the 1,875 acres of land. Commission personnel then installed two thirty (30) inch pipes with water control structures through the levees.

During the 1955 and 1956 waterfowl seasons the commission depended on rainwater to fill the area. Depending on this source of water, the area was not assured of filling until the later part of the season; thus, hunters were not receiving the full benefit of the area. In 1957 the Louisiana Department of Public Works constructed a water control structure on Irwin Lake with a canal from this point to Little Lake Lafourche to Crew Lake and on into the Public Shooting Area. By using Irwin Lake as a source of water supply the Louisiana Wildlife and Fisheries Commission is now in position to fill the area prior to waterfowl seasons. The water can then be released after the season is completed, not injuring or damaging the forest species. This type of area is referred to as a "Green Forest" type.

Waterfowl hunters may now look forward to shooting this area with good mallard potentials.

FINCH BAYOU PUBLIC HUNTING AND FISHING AREA

A new area for Public Hunting and Fishing was constructed in 1956 on Finch Bayou in Union Parish. The area is located approximately four miles east of Haile, Louisiana, on the Ouachita River.

In constructing this area a dam was built at the northern end of Finch Bayou and the present dam on Harrell Lake was raised. By doing this approximately 600 surface acres of water is being held. The area has produced fair fishing and waterfowl hunting since its completion.

A water control structure was placed on the Harrell Lake end for water fluctuation purposes. The improvement was constructed by the Louisiana Department of Public Works.

FISHER CREEK PUBLIC HUNTING AND FISHING AREA

The location of the Fisher Creek Public Hunting and Fishing Area is three miles west of Sondheimer, Louisiana in East Carroll Parish.

A small earthen dam was placed at each end of Fisher Creek Brake to form this Lake. The area is approximately 500 surface acres in size.

The lake area has cypress and bottomland hardwoods dispersed throughout it. Since its completion, the area has furnished good fishing and fair waterfowl shooting.

Fisher Creek Hunting and Fishing Area land was secured from the H. L. Hunt Oil Company on a long term lease without fee.

SHILOH CREEK PUBLIC SHOOTING AREA

Shiloh Creek Public Shooting Area was constructed for the purpose of a waterfowl hunting area. Its location is approximately five (5) miles west of Vaughn, Louisiana and borders the Terzia Game Management Area. It comprises approximately 1,200 acres of water area when full.

To make this area, a dam 415 feet in length was constructed across Shiloh Creek. The dam is five to seven feet in height with a fifteen foot crown. A pipe thirty inches in diameter and twenty feet in length with a control gate was installed so that water levels may be regulated.

Rainwater is caught on the area prior to waterfowl season and released after the closing date. By letting water off before spring growth starts timber is not injured.

This area has produced some good mallard and woodduck shooting. The commission is now working on a permanent source of water so that the area may be flooded or water let in as the need arises.

CHICAGO MILLS REFUGE

The Chicago Mills Refuge is composed of parts of the Old Singer Game Refuge and Ayers Wildlife Refuge and consists of approximately 50,700 acres of mixed bottomland hardwood habitat. Of the total acreage in the refuge, 49,200 acres lies within Madison Parish and 1,500 acres within Tensas Parish. This area provides suitable habitat for deer, wild turkey, squirrels, rabbits, and to some extent, waterfowl.

Maintenance and construction work performed during the last 2 years are as following:

1. Boundary line
    a. 124 miles of old line were re-worked.
    b. 124 miles of old line were re-painted.
    c. 1720 boundary markers were replaced.
2. Roads
    a. 25 miles of old jeep roads were re-worked.
    b. 12 miles of new jeep roads were constructed.
    c. Several miles of jeep roads were constructed in conjunction with deer trapping operations.
3. Salt licks
    a. 4 old salt licks were re-salted.
    b. 1 new salt lick was established.

Deer trapping operations are carried on yearly within the north-central portion of the refuge and will be discussed in another part of the report.

QUAIL DEVELOPMENT

A program for comparing annual quail populations on developed areas was initiated early in 1955 and is being continued until 1960. The purpose of this project is to determine whether hunting pressure influences next year's crop of quail and whether food plots such as these will localize coveys of quail on these areas. Accordingly, two similar areas in each of the seven districts were developed for quail. One of these areas in each district is being hunted and the other is not. At the conclusion of this period, an evaluation of all factors influencing this project will be made; then, the feasibility of continuing it will be determined.

Several interesting observations have already been made. There has been good evidence that quail are using the areas during certain periods of the year. Quail are the least of the problems associated with these areas. Food plots will localize coveys of quail under some conditions. Free-ranging cattle graze the edges of these fenced plots. In some instances, it appears as though these cattle owners have cut the fences so that the cattle could feed on these vegetative plots. Cattle and hog proof fences do not keep deer out, and they have entered freely and browsed these plots in some areas. Weather conditions influence the usefulness of these areas and agricultural crops similarly.

Cooperation of the landowners has been appreciated in their making more than 10,000 acres of land in all parts of the state available for this work. The areas open to hunting are available to the public. In some instances, this is with the landowners permission. Such a small courtesy on the part of the sportsman frequently means the difference between a place to hunt or no hunting.

This program is being modified in some instances to meet changing conditions. Reports covering these projects in Districts III and IV during the past two years will illustrate the types of and trends in this work and are presented below.

DISTRICT III QUAIL DEVELOPMENT AREAS

In 1955, fifteen one acre quail food plots were selected on an area of approximately 960 acres on open lands within Evangeline Game Management Area. In a similar area on U. S. Forest Service lands outside the management area twenty-two one acre plots were selected on approximately 1450 acres. These plots were fenced to exclude cattle and hogs and planted to quail foods.

As originally planned, one area, the one on the management area was not to be hunted whereas the other area was to be open to hunting. Quail populations were to be checked on both areas both before and after the hunting seasons. This project was designed to learn whether quail populations would remain relatively constant on a year to year basis on shot and unshot areas, if given equal food and cover conditions.

Press of other duties, lack of bird dogs, interference by cattle and deer made comparative censusing impossible. However casual checking of all the food plots showed considerable usage since the plots have been planted.

The first year, quail foods planted included millets, cowpeas, grain sorghum, common lespedeza, hegari, rice peas and upland rice. Deer have access to all the plots and those in the management area suffered considerably. The first season deer ate all the cowpeas, rice peas and some of the seed heads of hegari, millets and grain sorghum. Other plants had good to indifferent success.

The second year, 1956, all fifteen plots in the management area were replanted. In an effort to establish plants that could produce quail foods in spite of a growing deer herd, and capable of re-establishing themselves, common lespedeza and kobe lespedeza were the only foods planted with the exception of experimental plantings of chocolate weed. Only 12 of the 22 plots outside the management area were planted this year as checks of the plots showed ten with good stands of ragweed, partridge pea, common lespedeza and goatweed.

As before, evidence of quail continued to be found in the plots, deer continued to browse heavily and cattle were let into some of the plots. In spite of the grazing and browsing, more quail foods were produced as these plant species were more able to produce seed with grazing than those previously planted. Efforts were also made to improve cover by planting Multi-flora rose. Deer destroyed this planting before it became large enough to be effective.

In 1957 it was necessary to plant only three of the 15 management area plots and eleven of the other twenty-two. Partridge pea and brown top millet made up most of the plantings. Fair success was obtained with continual use by quail and damage by deer and cattle. However, due to the unusually heavy rainfall, weeds and grasses, particularly on those plots not replanted, had such a thick and heavy growth that, where quail should have used them considerably, they couldn't except around the perimeter of the plot.

All of the above plantings were fertilized at the rate of 200 lbs. per acre. It must be realized that this effort to increase quail populations is on cutover land, not suited to agriculture and in an analysis of results this must be considered. In the main, quail foods used are agricultural crops and growth and seed production cannot be compared to fertile, well drained farmland. On many of the plots, topsoil has practically washed away. Also, the fact that these plots are more or less isolated islands must be considered in evaluating their usefulness. The heavy cattle population in each area precludes any development work without costly fencing. Sericea plantings for nesting and loafing cover will be made within the plots but normal gound cover of weeds and grasses is needed as well as escape cover.

It is known that the plots within the management area were instrumental in increasing the total kill on the recent managed quail hunt. Local hunters have also been hunting considerably in the other area, both for quail and doves.

DISTRICT IV

QUAIL DEVELOPMENT AREAS

The LaSalle Quail Development Area is located in cutover pine-hill land and consists of 2,200 acres in LaSalle Parish approximately three and one half miles north of Jena, Louisiana. This project, initiated in 1955, is being conducted on private land through the courtesy of the Nebo Oil Company.

The development area is divided into two sections, the West Pasture which includes 1,000 acres and the East Pasture which totals 1,200 acres. Cattle are present on both areas, therefore fencing of food plots was necessary.

1956 Plantings

In 1956 twenty-five food plots were planted to cowpeas, soybeans, cattail millet, and grain sorghums (Red Amber & Hegari) sown in mixtures within each plot. In addition to the above, an 8 foot strip of chocolate weed and goatweed was planted around each plot (next to fence) to reduce damage by cattle.

Of the 7 plants used, the soybeans produced the poorest stand. The year 1956 was considered a drought year, and the plantings were not as successful as the previous year because of weather conditions and damage from cattle. Due to the cattle damage, the chocolate weed and goatweed were better producers than the other plants used. The millet and sorghums produced good growth and seed heads, but due to cattle being turned into the fenced plots by unknown persons the chocolate weed and goatweed were the best all round plants.

In February, 1956 multiflora rose seedlings were planted in four plots on the area to test the feasibility of the plant in pine-hill terrain. Of the 2,000 seedlings planted, 95 per cent had survived by April, 1956. By 1957, most of the plants were still living but growth was very poor. The use of multiflora rose in pine-hill habitat of District 4 cannot be classified as successful.

1957 Plantings

Development work during 1957 differed greatly from that which occurred in 1956. Some of the main changes in the previous program were: (1) the use of different plant species as food crops, and the method by which the plants were seeded within each food plot, and (2) the use of unfenced food strips upon fire lanes and pipe line rights-of-way.

Food Plots

In June the 25 permanent food plots were reseeded with browntop millet, chocolate weed, sesbania, partridge pea, and goatweed sown in individual strips rather than in mixtures. Thirteen plots received a fertilizer application of 400 pounds per acre, 10 received 100 pounds per acre, and 2 received zero pounds per acre. The seeding rate, for each plant used, was constant for all plots within which that plant occurred. Considering all plots, goatweed strips occurred in 14 plots, sesbania strips in 12, chocolate weed in 24, browntop millet in 11, and partridge pea in only 6.

In evaluating these food plants, sesbania produced good growths and cover within all plots, browntop millet was a very good seed producer, chocolate weed was rated as good, and partridge pea and goatweed were considered very poor due to very sparse stands within plots where they occurred. Before a final decision can be made one must consider the excessive rains which occurred in July, 1957 and the damage done by them. Within each food plot containing a partridge pea strip an excessive amount of erosion occurred. Poor results from goatweed strips are believed to be due to the quality of the seed used.

Fire Lines and Pipe Line Rights-of-Way

In addition to continued research on the 25 food plots, other experimental work was conducted on fire lanes and the pipe line right-of-way which crosses the eastern side of the development area.

Fire lane research consisted of planting goatweed, sesbania, and browntop millet singly and in mixtures with the fertilizer rate for all strips being zero. Results of the above plantings were unsatisfactory mainly because quality of seed (goatweed), heavy rainfall and damage done by livestock.

Research on the pipe line right-of-way consisted of planting individual plots of goatweed, chocolate weed, sesbania, and partridge pea, on areas with fertilizer applications of 0, 200, and 400 pounds per acre. Seeding rates, for each type of seed used, were constant on all strips. Poor stands and plant growth were produced on all plots due to the use of the pipe line right-of-way as a grazing, loafing, and bedding area by range cattle.

ENGINEERING

AND

CONSTRUCTION SERVICES

WILLIAM E. ACKLEN

Engineer

Maintenance of Commission properties and new construction of facilities for the fishing, hunting, and recreational needs of Louisiana have been continued during this biennial period. Carpentry crews have repaired, remodeled, and painted existing offices, caretakers' homes, shed and warehouses where needed to meet present requirements and maintain them in a good state of repair. Small radio transmitter houses located adjacent to the radio towers have been built in addition to one research greenhouse and a few equipment sheds. A new seaplane ramp was constructed at Pass-a-Loutre Headquarters. Heavy equipment has been utilized for building levees for waterfowl projects, clearing boat roads, building access and approach roads, building a small impoundment, and for continuing the remodeling of the Monroe Fish Hatchery Ponds. This work was performed on areas which are under the supervision of the Commission or on areas open and available to the public.

Surveys have been conducted of potential waterfowl and fishing areas. Plans, specifications, and maps have been prepared for water control structures and waterfowl area developments. Preliminary plans have been completed for the Wisner and Biloxi land company and marshes and the Bonnet Carré Floodway waterfowl developments. A fish scale projector was designed and built. Maps, plates, and figures were prepared for the publication of waterfowl and fisheries research project reports.

In addition to these activities within the Fish and Game Division, services of these personnel have been available to other divisions within the Commission. They were utilized by the Oyster, Waterbottoms, and Commercial Seafoods Division for completely renovating the old Coast Guard house on Grand Terre for staff quarters. Also, assistance was given in the supervision of construction of the canal, turning basin, and wharf at the site of the new marine biology laboratory.

PREDATOR CONTROL SECTION

T. E. HARRIS
Supervisor

The greatest problem this section has had to contend with during the last two years has been rabies among foxes. Beginning in Bossier and Claiborne Parishes, rabies has spread east to the Ouachita River, west to the Tensas line and south to Allen, Beauregard and Calcasieu Parishes.

Varying degrees of success have been obtained in coping with this situation. During the greater part of 1956 the Predator Control Section consisted of two trappers and a supervisor. As outbreaks of rabies were occuring in several parishes simultaneously, we were forced to ask for aid from the affected parishes. This was provided in the form of parish bounties or parish trappers, with the personnel of this section supervising the work and giving trapping instructions to high school boys at various schools in the state. In November 1956 thirteen new trappers were hired and trained.

This program was greatly handicapped by organized opposition—groups who opposed any type of fox control. Consequently in several parishes rabies was widespread before any successful effort could be made to reduce the number of foxes.

Wolves have increased in the northwestern parishes, while the trappers were engaged in fox control programs as the rabies epidemic was moving across a great portion of the state.

The record of the predator control section is as follows:

(State Trappers)	*Skunks*	*Wolves*	*Housecats*	*Foxes*	*Bobcats*	*Misc.*
1956	292	16	50	1078	60	665
1957	1075	16	522	1654	148	3432
Total	1367	32	572	2732	208	*4097
(Parish Bounties)..	....	....	....	1758	....	....
Grand Total ..	1367	32	572	4490	208	*4097

* Principally, Opossums

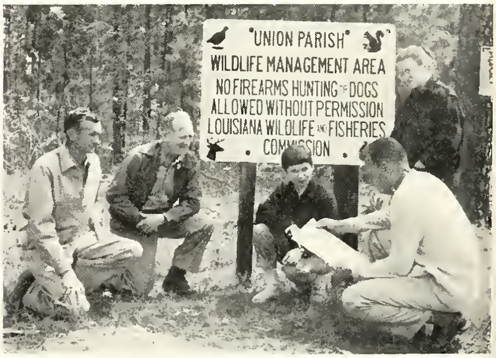
In conclusion, the outlook for the immediate future is herewith presented. The fox population is relatively low, especially where rabies has occurred. The wolf population is low but slowly gaining, especially in the northwestern parishes. The bobcat population is high in the northeastern and southcentral parts of the state.

RESTOCKING FIELDS AND STREAMS

In the summer of 1956, the Commission directed that game and fish would be restocked that year in suitable places in Louisiana to establish new game populations or bolster dwindling populations for future generations of Louisiana sportsmen. This re-established program would provide immediately for fish, then quail in the early fall, and deer through the winter. Accordingly, fish crews were established for handling their phase of the program, and arrangements were made to purchase bob-white quail at a reasonable cost from recognized quail farms. A total of 16,000 birds were purchased in the fall of 1956 at a cost of $1.37 to $1.50 per bird at ages of 10 to 18 weeks. It was thought that this was the best procedure for several reasons: (1) Being young, they could better adapt to and survive in the wild, than older birds. (2) More native food and cover was available for the birds then than at any other time of the year. (3) Birds of this age were more economical to purchase than year old birds costing about $3.00 each. Game agents made surveys of habitat conditions and the sincerity of landowners in each parish. Small numbers of quail were made available to each of those landowners where suitable conditions existed. It was recognized that some of these birds might possibly be lost to the hunters' guns. However, in view of existing over-all bird populations in these areas, it was felt that this number would be extremely small.

The deer restocking program had been in progress for several years and was to be continued. For the past few years, it has been conducted by the Pittman-Robertson Federal Aid Section. The work conducted under this project, its requirements, and the number of deer restocked in various parts of the state during the past two years is described in a subsequent section of this division's report. However during the winter of 1956, a total of 85 Wisconsin deer were purchased for $10,625.00 from a recognized game farm. This guaranteed, live delivery price covered transportation of the deer to the release site. Selected localities of Louisiana were stocked with these animals. The purpose of bringing deer into the state from Wisconsin was to augment the established program of releasing deer native to the state, as well as, to import new deer blood.

A number of bodies of water were restocked with fish to make splendid fishing areas out of waters where fishing was virtually non-existent. These areas are listed and this operation is described more fully in a subsequent section of this division's report.


"UNION PARISH"
WILDLIFE MANAGEMENT AREA
NO FIREARMS HUNTING & DOGS
ALLOWED WITHOUT PERMISSION
LOUISIANA WILDLIFE AND FISHERIES
COMMISSION

Joe L. Herring, Supervisor, District II, discussing the Union parish game management area with a group of professors and students from the University of Michigan, School of Forestry and Game Management.

WATER HYACINTH CONTROL

J. G. DUTTON
Supervisor

This program is set up as a Section of the Fish and Game Division, under the direction of the Chief of the division.

The headquarters located at Rosedale has an office, a well equipped repair shop, and ample storage space for approximately two-hundred drums of 2,4-D and all other necessary supplies and spare equipment. A large yard is at hand for parking trucks and stacking boats, steel barges and empty drums.

Personnel of this Section consists of a Supervisor, six hyacinth control workers II, one maintenance repairman II, and 37 hyacinth control workers I. The senior hyacinth control worker II serves largely as a superintendent of operations and assistant to the supervisor in the overall control of the activities of all crews. The maintenance repairman II acts in the capacity implied by his title in maintaining and repairing outboard motors, spray pumps, boats and making minor repairs to trucks and automobiles used in the section. The hyacinth control workers I do the actual spraying of water hyacinths.

The objective of the program, killing water hyacinths, is accomplished by spraying these plants with a one-half of one percent solution of 2,4-Dichlorophenoxyacetic Acid, (one quart of acid concentrate to fifty gallons of water). Amine Salt formulation of the acid is used. This solution consists of at least four pounds of acid equivalent per gallon, which is sprayed at the rate of one gallon of concentrate, or two-hundred gallons of the solution, per acre of hyacinths.

Spraying must be done when the plants are free from excess moisture. If rain falls on the plants within three hours after spraying is done, they must be re-sprayed, because it takes at least three hours for the chemical to be absorbed into the plant for killing effect.

Because of the waxy surface of the hyacinth plant, it is necessary to add about three ounces of a powdered detergent to each fifty-gallon drum of spray solution to cause the solution to better adhere to the plants and thereby get a better coverage in spraying.

During the relatively warm spring and summer months, the hyacinth plant will die and sink within three to five weeks, depending on sunshine and atmospheric temperature. Conversely, during the colder fall and winter months, they will not die and sink as fast, sometime taking as long as ten to twelve weeks. However, best results are obtained when the plants are sprayed during the colder months after the leaves are withered by frost because their stems are greatly exposed making the plant more vulnerable to the spray. Also, translocation within the plant is downward at this time of the year and causes the absorbed acid solution to be taken directly to the rhyzome or heart of the plant quicker.

When the water hyacinths have multiplied sufficiently to form a thick, tight mat, the initial spraying is done by use of steel boats, with a pointed bow, propelled by outboard motors. A compartment with a capacity of 100 gallons is built in mid-ship for containing the liquid to be sprayed. Atop this compartment is mounted the spraying equipment. consisting of a small air-cooled engine connected by belt and pulleys to a small tractor pump.

This spraying unit throws a stream a distance of forty feet, with the outer ten feet fanning out for excellent coverage. The small garden-type nozzle can be regulated by the turn of a small knob to form a shorter fan-like spray-stream for covering plants near the boat.

The spray unit runs continuously because it is used for pumping water from the bayou or lake into the drum for mixing each batch of spray solution. The operator merely transfers the suction hose from the drum to the bayou to obtain water for this purpose. When the drum is filled, the suction hose is then returned to the drum and spraying is resumed.

The above described operation is made possible by having a relief valve installed in the pressure line which goes into operation automatically when the spray nozzle is closed. The use of this valve has also brought about a saving of from 20 to 30 percent of 2,4-D use by allowing the operator of the spray nozzle to close the nozzle when changing the direction of his spray from one batch of plants to another separated by open space where there are no plants. He merely closes the nozzle which automatically opens the relief valve to allow the solution to return to the mixing drum to be used again.

JOHN G. DUTTON

The steel boats are operated by two men, one navigating the boat with the outboard motor and the other doing the spraying from the front of the boat. Frequently, in the case of a tight mat of hyacinths, it is necessary for the front man to cut the mat with a sharp blade in order to move forward. Most mats can be penetrated by these boats when operated by a skillful motor operator, without the use of the cutting blade.

When hyacinths occur in scattered patches and have not matted, the spraying is done in a lighter aluminum boat carrying a fifty-five gallon drum for mixing the chemical as described above. The same type of spraying equipment is used when using this type of boat. This arrangement is easily used by one man when the plants occur in scattered patches or along the fringe of a lake or stream. Under these circumstances, the power for the boat is obtained by the use of a 5½ h.p. outboard motor. Where the hyacinth plants occur in a loose mat, this type of boat is used advantageously.

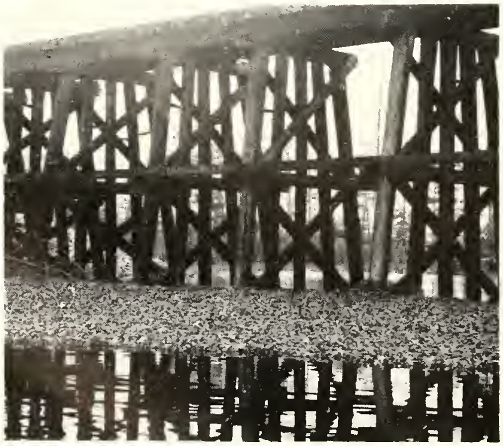
Aside from the saving in chemical used, both types of equipment bring about much saving in time and effort because of their lightness and flexibility, yet being very durable. Either type of boat and the full complement of equipment can be easily loaded and unloaded, to and from a truck, by two men when it is necessary to transport from one body of water to another, which is frequently the case.

We have designed and fabricated another type of equipment, the truck borne unit, which has proven to be very effective in spraying hyacinths under certain conditions. This unit, with its 560 gallon tank for containing the spray solution, has been used to spray many miles of bayous and canals where the footing alongside them is firm enough to support the truck. The chemical is sprayed from this tank (mixed in the same proportion as employed in mixing for the boats) by a fire-pump which produces pressure sufficient to throw a stream 125 feet without appreciable

Sam Hardcastle, biologist with weed control section, adjusting experimental spray. Spray being used on water plants in Chatham Lake, Jackson Parish.

fogging, and, in many cases is sufficient to reach completely across the stream or canal. This unit is used only in spraying tight mats that have never been sprayed, after which a mop-up operation is done with the aluminum boat unit.

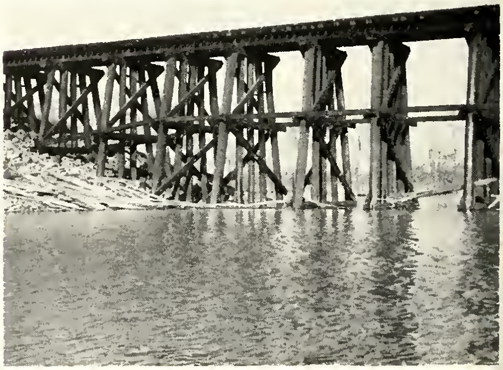
Many of the State's better lakes and streams are infested with underwater grass and weeds which make spraying the water hyacinths almost impossible by use of any floating equipment propelled by an underwater propeller. To surmount this problem, an air-boat has been used to a great advantage. In fact, experience has proven that this type of boat will be necessary to make a thorough job of the undertaking of removing or controlling water hyacinths on bodies of water of this type. This boat is now being completely altered to make it more efficient and economical to use. It is being lengthened to 20 feet from the original 14 feet, and will have a V-8 automobile engine to replace the aircraft engine formerly used, which required the use of the expensive and highly dangerous high octane airplane gasoline. This boat is covered with fiberglass and can navigate in extremely shallow waters, where many hyacinths are often found. In fact, it is said that an airboat can navigate over a "light dew". On the larger lakes, the fire-pump type of spraying equipment as now used on the truck-borne unit, will be used.



Before spraying hyacinths, Wallace Lake near Shreveport looked like this near the railroad trestle.

In the fight to control this insiduous plant, a complete job must be done, with periodic follow-ups, in order to obtain the desired results of getting the most for every dollar of tax-payers' money. This can only be accomplished by working in this manner in every section of the state. Even by full utilization of all the different types of equipment described so far, there are places that are still inaccessible and cannot be reached in order to spray hyacinths therein. Nor do we feel that such can be accomplished by use of the airplane or helicopter, with a degree of economy that limited monetary resources require. However, research conducted with the marsh-buggy as a means of transportation in spraying water hyacinths has proven conclusively that complete coverage can be obtained by its use in any section of the state. Every effort will be put forth to squeeze a limited number of dollars to the point that purchase of at least one marshbuggy for future use can be made. This contraption is more than amphibious because it is particularly adaptable for use over unstable marshes and wooded areas that cannot be worked by use of the boat, truck or airplane.

It is the policy to employ operating personnel, Hyacinth Control Workers I & II who reside near the bodies of water which they are to spray. This eliminates very costly travel and subsistence expenses. To this end operating stations at the following places have been set up.



Following a treatment of 2-4D, Wallace Lake is again cleared of the offensive hyacinth.

WALLACE LAKE, Caddo Parish. This station is manned by five Hyacinth Control Workers I and one Hyacinth Control Worker II.

LAKE BISTINEAU, Webster, Bienville and Bossier Parish. This station has nine Hyacinth Control Workers I and one Hyacinth Control Worker II.

HENDERSON, St. Martin Parish. Here, we have five Hyacinth Control Workers I and one Hyacinth Control Worker II. These crews are assigned to spray the hyacinths in the Atchafalaya River Spillway Section of St. Martin Parish. On account of the size of this area, this complement of personnel is much too small and should be augmented by another station, being set up 15 to 20 miles to the south of it.

SPRING BAYOU WATERWAYS, Avoyelles Parish. There are four crews here consisting of one Hyacinth Control

Spraying equipment and mixing tank mounted on 1½ ton stake-body truck.

Worker II and seven Hyacinth Control Workers I. These crews are assigned mainly to work the vast waterways in Avoyelles Parish reached from the Spring Bayou landing near Marksville. However, they are used for short trips of one or two days duration, for maintaining the control of hyacinths that has been obtained in Natchitoches, Evangeline and Rapides parishes. Their efforts have borne much fruit and it is felt that the goal of complete control of hyacinths in the Spring Bayou waterways is in sight.

ROSEDALE, Iberville Parish. There are four crews here consisting of seven Hyacinth Control Workers I and the senior Hyacinth Control Worker II. Their efforts are mostly utilized in the Atchafalaya Spillway section of Iberville parish. However, they are assigned to maintenance patrol work in Pointe Coupee, West Baton Rouge, St. Mary, St. Landry, St. John and other neighboring parishes.

BAYOU PIGEON, PIERRE PART, AND CROWLEY station are each manned by one crew of two Hyacinth Control Workers I to work the waters of their respective areas.

The man classified as Hyacinth Control Worker II serves in the capacity of Foreman over the crews of his station. He is responsible for keeping the work-time of all the men at his station, supervising the care and maintenance of all equipment, making daily work assignments for the crews, drawing equipment and supplies from the warehouse, seeing that all crews submit a weekly report of work and actually taking part in the operation of a spray unit as a sprayer or motor operator.

At the time supervision of this program was placed in our hands, there were many obstacles to overcome if the program would be allowed to survive. It was common knowledge that there was great danger of our spray going far afield from the water hyacinth, which was the object of the sprayer's aim, and causing much damage to growing farm crops, mainly cotton. Other crops of the farmer such as most truck plants, fruit trees, corn and most species of beans were very susceptible to 2,4-D damage or were completely destroyed if even minute quantities of this spray were to fall on their leaves. The growth of cotton is instantly halted and production of lint is a certainty not to occur in such cases.

The assumption of liability for damages of this type was too much for any agency of the State government to think about and after the necessity of a legislative appropriation to satisfy some of these claims in the northern part of the state, it was felt that remedial steps must be taken or the program be abandoned.

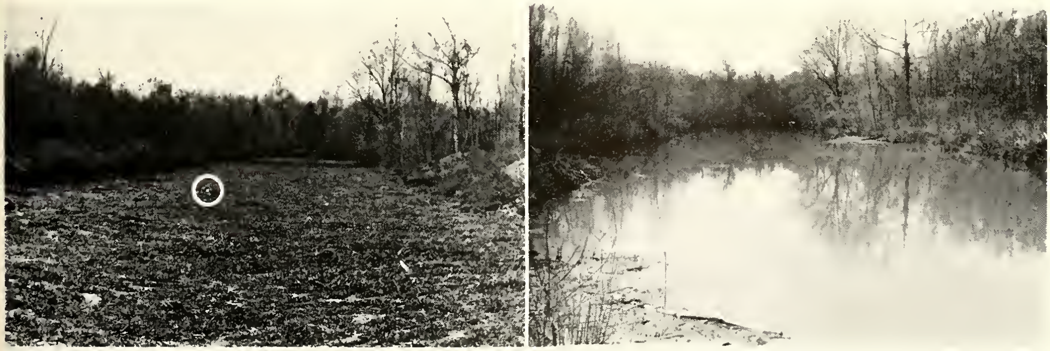
A close study of the problem quickly showed that the killing or damaging of the farmers' crops was caused by the vapor, or fog, from the spray gun being caught in the wind and carried to these crops. Obviously, it was not considered possible to control the velocity of the wind or to stop it. Our next problem was to find out what was causing the fog that drifted in the winds to the farmers' crops.

No great technical skill was necessary to arrive at a conclusion as to the cause for this. Gauges were placed on the spray-line of the pumping equipment which immediately gave us our answer when their needles registered pressures varing from 300 to 400 pounds per square inch through an aperture of from 3/16″ to 5/16″ in diameter. We concluded that research must be conducted with equipment that would produce much less pressure without sacrificing the length or type of the stream it would throw.

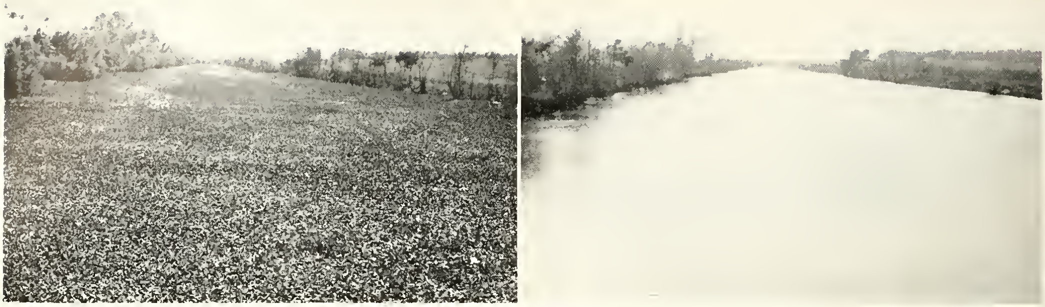
After considerable time and effort, our research lead us to standardize throughout the program with the use of the small engine and tractor pump shown in Figure 2. This unit produces pressures varying from sixty to ninety pounds per square inch varying directly with the speed of the engine.

Many types of nozzles were tried, from the most expensive ones at forty to fifty dollars each down to the relatively inexpensive type used at the end of many garden hoses, costing less than two dollars each. The latter type was adopted because of (1) its low cost, (2) its adjustability from absolute cut-off to a good stream thirty-five to forty feet in length, and (3) its durability.

To prove our contention that this type of equipment could be used in spraying water hyacinth in relatively close proximity to growing farm crops without harmful effect on them,



The condition of a very important drainage canal south of Sorento on Highway 71 is shown at left. This mat is about half and half water hyacinths and alligator weed. The circle indicates the presence of carcasses of dead cattle. Cattle are very fond of hyacinths as a food even though they have no nutritional value. They will wade into a stream to eat them and in many cases step off into deep water and drown. View at right shows this stream after being cleared of the water hyacinth mat which was evidently fostering the growth of the alligator weed.



At left, view of a barrow pit near Patterson before hyacinth control work was begun on it. This pit is 15 miles long and approximately 300 feet wide. As shown on the right, water hyacinths have been removed and now needs only one trip by one crew once a year in order to insure no recurrence of hyacinths by germination of dormant seeds.

we set out to spray water hyacinths on Cane River in Natchitoches Parish.

This project was started in the latter part of April 1953 when there was much cotton at a height of three to four inches. We continued throughout the entire growing season of cotton, to the latter part of September of that year. Our State Department of Agriculture was asked to check the cotton crops in the vicinity of our operations for any damage to this crop resulting from drift of spray. The Parish Agricultural Agent was also in on the inspection of our work, as was the Parish department of Health. Needless to say the cotton planter and our own supervisory personnel were vigilant. No damage, even remotely traceable to this spraying, was reported by any of the observers.

At the time the above described operation was initiated, Cane River was about two-thirds covered with a hyacinth mat. Old River was about ninety percent covered as was Bayou Derbonne. All of these streams were completely cleared of hyacinth during the Summer of 1953. Periodic follow-up patrol trips have been necessary on all. We now return to them once a year, with the exception of Cane River, which we have pronounced "cured". However, a close watch will be kept to thwart a recurrence of these vegetative pests by germination of seeds which may have lain dormant for many years on the muddy bottom.

Following the completion of the first operation on Cane River, the Fisheries Section undertook a complete kill-off of the rough fish and restocking with game fish. At this writing, this once highly favored game-fish stream is on the road back to its original rating as one of the best in the South.

Many successes have been brought about in reclaiming some of our better lakes and streams from the blanket of water hyacinths where no game fish can survive. These plants multiply very rapidly to form this mat over the water and do their most damage to fish life by shutting out the sunlight, which is necessary for the growth of plankton and small organisms for fish growth and by reducing the oxygen content of the water which is also most necessary for aquatic life. Aside from these two very harmful actions, they make navigation of boats by any means impossible to the extent that the commercial and sports fisherman could not harvest the fish crop should any survive.

Water hyacinths are no longer a problem on LAKE BISTINEAU in Webster and Bienville Parishes. This long lake of about thirty-five miles and from one to three miles in width now affords countless thousands of outdoor lovers the right to enjoy their natural heritage of fishing for sport and for monetary profit, as well as boating, skiing and swimming, unhindered by the water hyacinth.

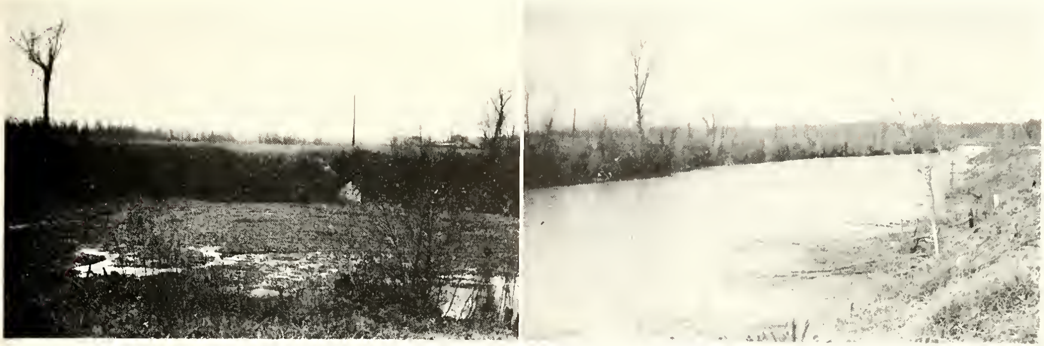
Another lake about sixty miles to the west is WALLACE LAKE which has been freed of water hyacinths and now offers the opportunity for unlimited fishing and hunting.

BLACK BAYOU LAKE in Ouachita Parish is now in excellent condition with respect to the absence of water hyacinths and is open for some wonderful fishing and hunting and all kinds of water sports.

BLACK, CLEAR AND SALINE LAKES in Natchitoches Parish have been returned to the fishermen and hunters. These lakes were never infested with hyacinths to the extent that they had become a menace. Saline Lake has only required token attention from our crews which have maintained excellent conditions with respect to absence of hyacinths.

The vast water-ways of AVOYELLES PARISH have long been recognized as the greatest in production of game and commercial fresh water fish. Our crews are doing an excellent job of keeping them in condition for the sports fisher-

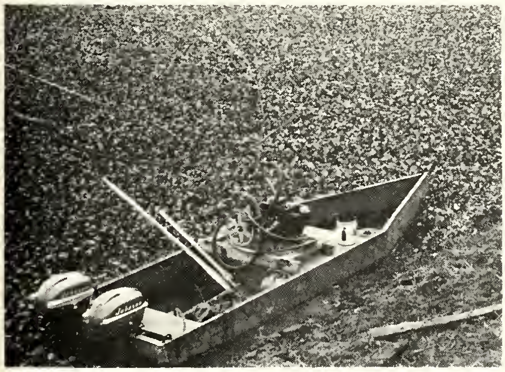
These scenes show how the water hyacinth mat can be a navigational obstacle. Two of these photos show the mat to the right and left of the ferry landing at Belle River (Intracoastal Canal). The other photo shows men engaged in pushing the mat to the side so the ferry can move forward. Before this mat was removed, the ferry was tied up for a three-day period because of it.



Alligator Bayou in Red River Parish near Cross Roads and about fourteen miles north of Coushatta. The root section of this mat extended downward to a length of eight feet. For this reason, it was the toughest job we have encountered in our work. Photo at right shows the condition of this stream at present.

man and commercial fisherman to harvest this crop. This area is also noted for waterfowl hunting and, due to the efforts of our hyacinth control crews, are constantly being used for all these purposes.

That section of the ATCHAFALAYA SPILLWAY lying in Iberville Parish and partly in St. Martin Parish is again open for fishing and water sports, and many fishermen look to these waters for a livelihood because of their high production of commercial fisheries. These waters also offer much sport to thousands of sports fishermen and hunters from the metropolitan area of Baton Rouge.



Spraying equipment mounted on steel boat, sometime called a barge.

Southeast Louisiana, known as the Florida Parishes, has many streams that abound with both game and commercial fish. TANGIPAHOA RIVER, AMITE RIVER, NATALBANY RIVER, TICKFAW RIVER, BLOOD RIVER, COLYELL BAY, BAYOU BARBARA, ALLIGATOR LAKE and BLIND RIVER, are all free of water hyacinths and are being maintained in that condition by our crews stationed there.

In St. Tammany Parish and Washington Parish, the Tchefuncta River and its miles of tributaries and many miles of other small bayous and canals are now free of hyacinths and being maintained in that condition by our crew stationed at Madisonville.

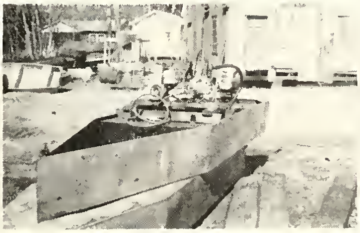
Further East, our crew stationed at Slidell is gaining fast on the water hyacinths found in the Pearl River Waters and the many miles of small bayous and canals in that vicinity.

Within sixty-five miles of Baton Rouge, we have a crew stationed at Pierre Part Bay which has been highly successful in keeping Big and Little Pierre Part Bayous, Grand Bayou, Lake Verrett and many miles of small bayous and canals unobstructed by water hyacinths. From these waters and those around Bayou Pigeon and Bayou Sorrell, where we have another crew stationed, come our best crops of highly delectable crayfish. These waters also offer excellent sport and commercial fishing, as well as all kinds of water sports.

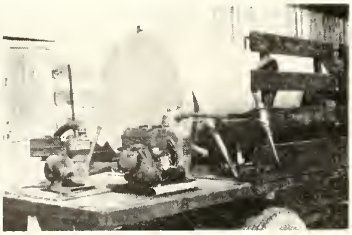
With the above cited achievements in removing the water hyacinths from the streams and lakes mentioned and maintaining them in such condition, we have not yet been able to see the full accomplishment of our job. There are many areas of our State in which we have been unable to work because of the lack of sufficient funds to finance a full scale program. Southwest Louisiana and the area south and east of New Orleans need attention and it is planned that systematic work will begin in these areas if and when those present jobs are completed and we are able to transplant our efforts to them, when and if additional funds are made available.

NOXIOUS AQUATIC WEED RESEARCH. An interesting observation of the results of our efforts to kill water hyacinths is that we are succeeding in this respect, but possibly are thereby making conditions more suitable for

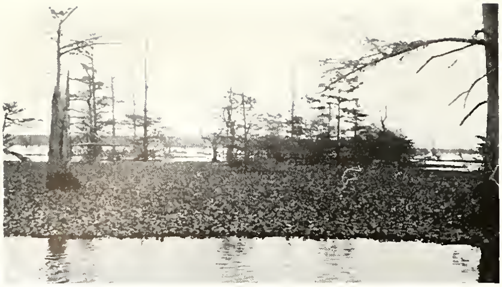
Equipment in 14′ Aluminum Boat



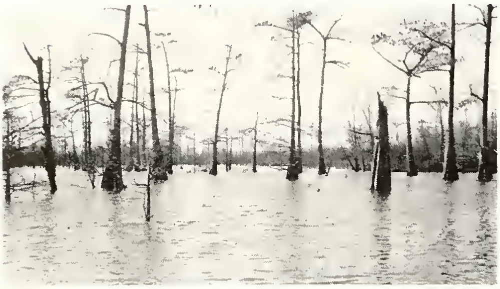
Same in Steel Boat



Tank Truck Equipment



A Section of Wallace Lake, Caddo Parish—Before



A Section of Wallace Lake, Caddo Parish—After

the growth or spreading of other noxious aquatic plants, particularly the underwater type such as coon-tail moss, cabomba and parrots feather, and very definitely Alligator weed. This latter plant grows from a submerged rootstock and spreads over the surface of our waters to form an almost impenetrable web of vine-like stems. A Research Section has been set up in conjunction with the Hyacinth Control Section whose problem will be to discover ways and means of killing or controlling these and other noxious aquatic plants. It is hoped and anticipated that the use of herbicides or other chemicals will be the answer and that personnel of the Hyacinth Control Section will be employed in this expanded work. A full treatise describing the project work of this research will be found elsewhere in this report.

NOXIOUS WEED CONTROL RESEARCH PROJECT

W. S. HARDCASTLE

Project Leader

The semitropical to subtropical climate of the state favors a lush vegetative growth; when this growth is controlled and directed it results in high yields in marketable farm and timber crops. However, these same conditions favor the growth of weed species which crowd out desirable game food plants and grow in and on the lakes and streams of the state and interfere with the production and harvest of game and commercial fish from these waters.

The profitable utilization of land and water resources is dependent upon well conceived and well executed management programs for these resources. Good management presupposes knowledge of the various complex forces acting for and against the ends desired, and of the most appropriate means of their manipulation to bring about the desired results. This knowledge may be gleaned from long periods of trial and error with the resultant false steps and costly mistakes inherent to this system, or it may be gained through the directed and concentrated efforts of controlled research. In the proper management of wildlife and fisheries resources, as in agriculture, an important consideration is the manipulation of the vegetation present in an area, be it land or water, to the end that the desired types will have the least possible interference from the competition of unproductive and undesirable weed species.

Since biological and mechanical methods, which have been tried in the past for the control of aquatic weeds, have met with little success, this project is embarked on a program of controlled testing of herbicides to determine their effectiveness and possible usefulness in field management programs aimed at increasing the harvest of the fish and game resources of the state.

During the biennium 1956-1957 the work of the project was primarily that of conducting pilot studies to develop rapid, effective techniques for handling a large number of test chemicals in experiments to determine their usefullness against aquatic weed species. Limited field tests of a developmental nature were also undertaken on certain species.

Publications of the project outline methods of rapid analysis of the effect of various herbicides on alligator weed *(Alternanthera philoxeroides)*, coontail *(Ceratophyllum demersum)*, parrot feather *(Myriophyllum brasiliense)*, waterweed *(Elodea densa)*, and fanwort *(Cabomba caroliniana)*. These experiments, primarily of a laboratory nature, involved more than 250 separate chemical concentrations and in excess of 2,400 individual tests.

Through this extensive type of controlled testing of chemicals, the techniques developed in the pilot studies have been proven to be accurate within the demands of the overall objectives of the study, and have proven to be economical of space, time, and operating personnel.

By the use of these techniques, chemical treatments have been developed which show promise of being economically useable for the field control of some of the more than 30 different genera of aquatic pests which hamper the sport and commercial fishermen at present in their efforts to harvest fish in inland waters. Further testing of these materials under controlled conditions in small plot and field tests will be necessary before final evaluation of their effectiveness can be made.

Since the improvement of fishing is the primary object of aquatic weed control, each chemical which shows promise is evaluated early in the program for its effect on fish; materials which prove to be toxic are deleted from the tests.

The encroachment of undesirable weed species has seriously reduced the production of desirable food plants in certain of the better waterfowl areas of the state, particularily on Catahoula Lake where the food production potential of approximately 4,000 acres of wild millet and chufa have been lost because of shading by water elm and swamp privet. Pilot studies of the use of chemicals to assist in the restoration of this important acreage to its full production of food plants have been initiated.

In addition to the basic research activities conducted by the project, periodic field surveys by boat and plane are made to determine the extent of infestation of water weeds, to determine the effectiveness of control measures, and to determine the types of plants which are replacing weed species in treated areas. This last is a very important consideration in maintaining cleared areas and preventing their reinfestation by the same or another weed type which could become a serious pest.

Continuous liaison is maintained with the operating personnel of the Water Hyacinth Control Section to assure that the findings of the project are immediately available to the units in the field and to render any possible assistance toward the futherance of the effectiveness of their work.

FISHERIES SECTION

HARRY SCHAFER

Supervisor and Dingell-Johnson Coordinator

HARRY SCHAFER

THE Fisheries Section is charged with fish research, lake management and the rehabilitation of the waters in Louisiana. The section consists of seven fishery biologists, two biological aides, seine fishermen, three fish hatchery managers and part-time student help. Under the Dingell-Johnson Federal Aid Program, there are currently four research projects under way. The money for these projects is obtained by the Federal Government by collecting a manufacturer's excise tax on sport fishing tackle. The funds are apportioned to the States and matched in the ratio of seventy-five percent Federal and twenty-five percent state moneys. The apportionments to the states are based on the area of he state and the number of fishing licenses sold in the state. This means that the more fishing licenses that a state sells, he larger the federal apportionment will be. For this reason, many states are now requiring a fishing license for everyone who fishes. The money for the State Projects and the operaion of the fish hatcheries is from the Fish & Game budget. With this money there are four state projects under way.

It should be pointed out that even though there are only ight projects (4 Federal and 4 State) each project consists of a number of jobs. For an example, D. J. Project F-4R has welve different jobs covering various phases of research.

The farm pond project is important in that it adds many housands of acres of fishing waters to the State. If these waters are managed properly, the fishermen will be very uccessful in their catches. It is always recommended that he ponds be opened to public fishing, as this heavy fishing prolongs the life of a balanced fish population. No body of water in the State is stocked with fish unless a fishery biologist checks the population in the water to ascertain if fish are needed. Adding fish to waters that have existing populations usually produces an unbalanced fish population and fishing success diminishes.

Wire noose used for gar fishing.

This Section is relatively new and it is realized that there is much yet to be accomplished. It must be realized that research is expensive and time consuming, but when management plans and tools result from the research, better fishing is realized. The following are some important projects that should be initiated to improve sport fishing when funds and personnel are available; more lake and stream rehabilitation, which includes balancing the population, clearing streams for float trips, etc.; more access roads and launching facilities built so that our existing waters can be more fully utilized; a State-wide creel census to obtain the quality of fishing; checks on our present management tools, and many others.

The following reports, prepared by the project and assistance project leaders, cover each project in the Fisheries Section.

STATE PROJECT

FISH AND LAKE MANAGEMENT

Don Geagan
Project Leader

Charles Fuss
Assistant Project Leader

It is the responsibility of this project to answer requests of civic groups, police juries, sportsmen organizations and citizens regarding fisheries problems throughout the state. Also included under this project are research jobs which are undertaken for the purpose of obtaining information on local fisheries problems.

The following work was undertaken by this project during the biennial covered in this report.

Fishways:

The Lake Chicot fishway study which began in 1954 was terminated in 1956. The operation of this fishway was the same for 1956 as was described for 1954-1955 in the biennial report for that period.

Table No. 1 illustrates the number and kinds of fish using this structure during 1956.

TABLE NO. 1

Species	No. Using Fishway	% of Total No.
Largemouth bass	271	4.82
White Crappie	16	0.28
Bluegill sunfish	3642	64.77
Redear sunfish	184	3.27
Longear sunfish	51	0.91
Warmouth	4	0.07
Blue catfish	13	0.23
Yellow catfish	13	0.23
Buffalo	20	0.36
Carp	1	0.02
Shad	1408	25.04
	5623	100.00

Included below is the summary of the final report for this study:

1. The Lake Chicot fishway was the first structure of its kind constructed in Louisiana for the purpose of stocking an impoundment of this type.

2. Certain species of fish gathering below a spillway structure, such as is found on Lake Chicot, will utilize a fishway of this type for gaining entrance into the lake proper.

3. This movement is noted in the spring during and for a short time after the spring rains cause an overflow of the lake over the spillway.

4. Approximately one-fourth of the fish which utilize this structure are of species which are undesirable in a lake used primarily as a sports fishing lake.

5. Of the total number of fish using the way, approximately three-fourths were game species but only 6.03% of these were of available size for 1955 and only 7.19% for 1956.

6. Bluegill bream constituted 63.94% of the fish using the way for 1955 and 64.77% for 1956. It is doubtful that these fish were needed since the bluegill has illustrated its ability to maintain and even exceed its place in a balanced population due to its prolific ability to propagate itself.

7. Of the rough fish using the way, the majority were shad and the shad has proven itself to be an undesirable species in Louisiana.

8. Tagged fish caught the second time in the trap showed that, at least, a portion of the fish (1.8%) were returned back below the spillway by the overflow.

DON GEAGAN

9. It is the opinion of the authors that a structure, such as this, is not desirable for a Lake Chicot type impoundment. Such a structure provides little harvest for the sports fisherman. Only 22 fish or 2.9% of the 760 available sized game fish tagged were returned, and these 760 tagged fish represented 87.9% of the total number of available sized game fish utilizing the fishway. Also such a structure gives access into the lake for large numbers of undesirable fish such as shad and undersized sunfish. Both of which have proven themselves nuisances in Louisiana waters because both have a tendancy to become over abundant.

The Lake Bistineau fishway was operated during 1956 but not during 1957. The operation of this fishway was the same for 1956 as was described in the 1954-55 biennial report. The final report of this fishway is to be completed in the near future.

Impoundment Studies:
Black Bayou Lake, Caddo Parish.

This study is being conducted to evaluate the effects of the four foot raising of the water level of Black Bayou Lake in 1954. The information obtained in this project should be of considerable value since numerous requests are made annually for the raising of different impoundments throughout the state for the purpose of improving sports fishing. The results of this study should show whether or not any such improvement in the fish population composition and production does take place and if so how long such improved conditions last.

In the late summer of 1956 and 1957, five one acr

Applying strap tag to bluegill operculum for tagging studies.

Taking fish scale samples

Fisheries biologist mapping pond preparatory to management program.

rotenone samples were collected each year. The method used is the same as described for this study in the 1954-55 biennial report. These samples were collected in approximately the same locations each year. It is intended that this study be continued through the next biennial.

Caddo Lake, Caddo Parish

This study of the Caddo Lake fish population has been continued through the period covered by this report. It was initiated in 1954. During the summer of each year, six one acre rotenone samples were collected. The results of these samples were helpful in the preparation of a report recommending the opening of this lake to commercial fishing as an aid in reducing the amount of non-game fish present. It is intended that this project be continued through the next biennial as the results of this study are being correlated with the Dingell-Johnson Project F-6-R.

Iatt Lake, Grant Parish.

This is a new impoundment which contained water for the first time in 1957. Two one acre rotenone samples were taken this year along with field water chemistries, plankton samples and benthos samples. It is the purpose of this project to make a study of the development of the fish population of this new impoundment along with a general ecological study. This information should be of value in helping to establish the development of the problems characteristic of the large shallow type impoundments which are numerous in Louisiana. It is intended that this project be continued through the next biennial.

Selective Poisonings:

Cane River Lake, Natchitoches Parish.

Following the poisoning operation of Cane River Lake in 1955 (see Biennial Report 1954-55) there has been a development of a large threadfin shad population. This threadfin shad population has been noted in the three one acre rotenone samples taken each summer. In addition to these rotenone samples a series of seine hauls are made each winter and sampling is also conducted with hoop nets. These hoop nets are fished in series of three nets which are attached together by 4 ft. x 40 ft. leads with the middle hoop net having an opening at each end. These nets are very efficient in sampling the black bullhead and carp populations which are also threatening to become a serious nuisance.

Crews making application of rotenone in selective poisoning operation.

In the fall of 1957, five percent powdered rotenone was applied to the entire lake's surface at a concentration of 0.1 part per million. A very satisfactory kill of threadfin shad was accomplished. The success of this operation will be determined in the 1958 rotenone samples. The cost of the chemical used in this selective poisoning operation was shared equally by the Natchitoches Parish Police Jury and by the Louisiana Wildlife and Fisheries Commission. It is intended that this project be continued through the next biennial as the results in improved fishing justify such an operation.

Bayou DeSiard, Ouachita Parish.

Selective poisoning for this body of water was undertaken during the last week of October 1957 after it was shown thru rotenone samples collected by Victor W. Lambou, 1954, and James T. Davis, 1957, both fisheries biologists for La. Wildlife and Fisheries Commission, that the shad population made up approximately 70% of the total population.

The chemical used in this operation was purchased by the sportsmen of Monroe and the surrounding area. The 5% emulsified rotenone was applied by Louisiana Wildlife and Fisheries Commission personnel using Commission equipment. Application was made at the rate of 0.1 p.p.m. and was sprayed on the surface with a portable power spray unit. Approximately fifty-five tons of rough fish killed in the operation were picked up by the contracted crews, who were paid with money donated by local citizens interested in seeing this project undertaken.

This project has been a splendid example of cooperation between the local sportsmen and the Louisiana Wildlife and Fisheries Commission. It is hoped that this project may be continued through the next biennial. The success of the poisoning for 1957 will not be fully known until the results of the 1958 rotenone samples are available.

Audubon Park Lagoon.

Seine hauls were made in this body of water during the early summer of 1957 in conjunction with a fish tagging project. At that time it was noted that the greater portion of the fish population of this 11 acre body of water was composed of gizzard shad. Upon the recommendations of the Louisiana Wildlife and Fisheries Commission Fisheries Section, Mr. George Douglass, Audubon Park Superintendant, agreed to have the selective poisoning undertaken. Application was made with project personnel and equipment in early November 1957. The concentration applied was 0.1 p.p.m. The chemical used in this project was donated by the manufacturer for purposes of research since it was a new formulation designed to be more effective at low tempertures.

Large quantities of gizzard shad were killed in this project, however, no figure as to the quantity collected was kept by the Audubon Park crews who cleaned the area of all dead fish. It is intended that this project be continued through the next biennial.

Fish Population Sampling:

Sampling reported under this section is that which has been done at the request of various sportsmen organizations, civic groups, police juries and individuals. The results of these samples are valuable in inventorying the waters of Louisiana with regards to their fish populations. These results along with any recommendations which are deemed necessary for a management program are forwarded to the group or individual interested in them.

Under this project rotenone samples have been taken in the following bodies of water during this biennial:

- Alligator Bayou, Red River Parish
- Amite Gravel Pits:
  - Holloway's Pond, Tangipahoa Parish
  - Mud Pond, Tangipahoa Parish
  - Stump Pond, Tangipahoa Parish

Fisheries crews preparing to make sample seine hauls.

Patterson Borrow Pits, St. Mary Parish
Lake Bruin, Tensas Parish
Chatham Lake, Jackson Parish
Davis Lake, Caldwell Parish
Krotz Springs Borrow Pits (4 pits), St. Landry Parish
Sayres Lake, Richland Parish
Buzzard Island Lake, Richland Parish
Sand Lake, Beauregard Parish
Upper Caney Lake, Webster Parish
Lower Caney Lake, Webster Parish

Additional requests have been received for this type of survey for the summer of 1958.

STATE PROJECT

FISH HATCHERIES

Sammy Stokes

Project Leader

There are three state fish hatcheries maintained and operated by the Louisiana Wildlife and Fisheries Commission at the present time. These fish hatcheries are Beechwood Fish Hatchery at Forest Hill, the Huey P. Long Hatchery at Lacombe, and the James A. Noe Hatchery at Monroe. At the present time all the hatcheries are producers of fish.

In the past two years Beechwood has produced 125,000 bass and 600,000 bluegill. The Monroe Hatchery has produced 100,000 bass, and 500,000 bluegill. The Huey P. Long Hatchery has produced 50,000 bass. These fish have been placed in various public fishing places and private ponds throughout the state.

At the present time these hatcheries produce two crops of fish yearly with the exception of the Huey P. Long Hatchery at Lacombe which produces only bass. By raising two crops of fish annually the number of fish produced is increased while the expense and effort is decreased.

The species of fish produced by the hatcheries are large-mouth black bass (Micropterus salmoides), and the bluegill sunfish (Lepomis macrochirus) and black crappie (Pomoxis nigro-maculatus).

An experimental pond of black crappie at the Monroe Fish Hatchery proved to be fairly successful. This fish will be stocked in the hatchery ponds again this year.

The black bass brood fish are placed in ponds in the month of February and spawn usually in March or April. After the spawn is hatched, the small bass remain in schools for a period of about two weeks. During this time the adult bass care for them but as soon as the young bass begin to break their schooling habits, the adult bass begin to feed on them. Accordingly, the adults are removed from the ponds with a seine before they begin to feed on the young bass.

The small bass remain in the ponds until they reach fingerling size, approximately two or three inches in length. The ponds are then drawn down for the removal of young bass. The fingerlings are removed, weighed and placed in fish transport trucks and hauled to the various public and private waters throughout the state where the need for fish has been determined by Fishery technicians.

Immediately after the removal of the fingerling bass in June, the brood ponds are refilled with water and the bluegill brood fish are placed in these ponds to spawn. This spawn of bluegill is left in ponds until they reach fingerling size in December. They are then removed and placed in bodies of water in the same manner as the bass. The crappie are removed at the same time and in the same manner as the bluegill.

After the removal of the bluegill and crappie the ponds are refilled and again stocked with the bass brood fish, thus the cycle is begun all over again.

Removing fingerling from holding ponds at Beechwood Fish Hatchery.

Pond at Lacombe Fish Hatchery drawn down to remove the fingerling bass.

STATE PROJECTS FARM PONDS

The Farm Pond Project was designed by the Louisiana Wildlife and Fisheries Commission to aid people interested in farm pond fish production and management.

In the past two years, 156 privately owned ponds have been stocked with bluegill and bass, and twelve public places were stocked. These places include: Cocodrie Lake, Weem's Lake, Joe's Bayou, Anacoco Lake, Bundick's Creek, Whiskey Chitto Creek, Ft. Buhlow Lake, Iatt Lake, Sam Houston State Park, Attakapas Boy Scout Camp Lake, Old River, Black Lake and Valentine Lake.

During this time, 142 ponds were also checked. These ponds were checked to aid persons interested in obtaining advice concerning farm pond management. Of the number of ponds checked, it was recommended that rotenone be used in approximately 30% of them. The fish population in the ponds had become unbalanced due to an overcrowding of bluegill. Only four ponds were recommended for rotenoning due to a presence of trash fish, such as shad.

Fifty-five percent of the ponds checked were found to have a balanced population and were producing good numbers of fish of harvestible size. These were ponds that were fertilized regularly and were open to the public for fishing; therefore it is desirable for all private pond owners to invite the public to fish in their ponds as this has a tendency to give more pleasurable fishing over a greater period of time.

The other 15% were ponds that were new or had been rotenoned and were checked to be sure that they contained no fish before stocking. Fish are placed in these ponds by the Louisiana Wildlife and Fisheries Commission without any charge to the owner.

A person interested in obtaining fish for a new pond or having his pond checked should write to Mr. Harry E. Schafter, Jr., 126 Civil Courts Building, New Orleans, Louisiana. The person will be sent an application to be filled out and returned to the same address. He will then be notified when a fisheries biologist will be there to visit with him and talk over his problems or assist him in any way that he can in helping the pond owner to map out a suitbale management program.

STATE PROJECT
STRIPED BASS STUDY

Charles M. Fuss
Project Leader

A study was conducted on the Tchefuncta and Bogue Falaya Rivers during the months of March and April to determine the occurance of Striped Bass (*Roccus saxatilis*) in this area. Hoop nets were fished each day from Covington to the intersection of the two rivers with the hope of procuring enough specimens for tagging and reproduction studies. Unfortunately only three striped bass were reported taken in the area in 1957, removing all hopes for carrying the above project to completion. However, considerable data were collected on the chemical and physical properties of the two rivers during the course of the study. In the future, if substantial reports of catches are made by local fishermen in the area, the study will be resumed.

DINGELL-JOHNSON PROJECT F-6R-1
ECOLOGICAL SURVEY OF FACTORS AFFECTING FISH PRODUCED IN LOUISIANA WATERS

Donald Geagan
Project Leader

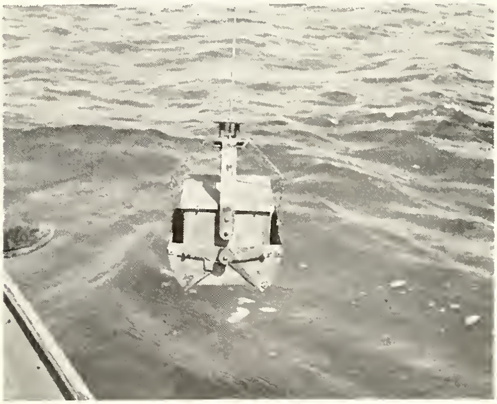
Charles M. Fuss
Assistant Project Leader

Dingell-Johnson Project F-6R-1, entitled an "Ecological Survey of Factors Affecting Fish Produced in Louisiana Waters" was inaugurated during the month of July, 1957. The objectives of the project are to determine what conditions are normal in the ecology of fresh water bodies of the state of Louisiana. Ecology, by definition, is the relationship of the organisms of a particular habitat to each other and to their environment.

In order to successfully establish good sound fishery management principals, it is first necessary to have a fundamental knowledge concerning the mechanics of the "food chains" of various water habitats. In simple language, a "food chain" is the production of natural fish foods beginning with the microscopic plant life which are capable of converting the inorganic chemical elements of the habitat into food for themselves. These are in turn eaten by the most primitive animal life which eventually contribute to the diet of fishes.

Four lakes were selected for the study as being representative of the major types of fresh water habitats found in the state; they are Lake Caddo, a large non-fluxuated impoundment; Lake Chicot, a relatively small yearly fluxuated im-

Sample is strained with No. 30 U. S. standard sieve.

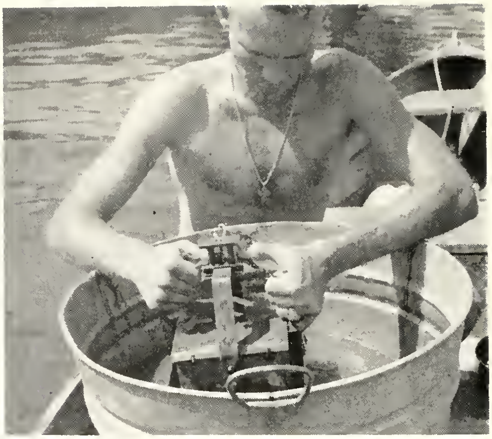


The Ekman dredge used to bring up sample of lake bottom for survey of fish food organisms found there.

Sample is removed from sieve and placed in bottle.

Sample is diluted with water and mixed to facilitate straining.

Preservative is added to sample which will be returned to the laboratory for detailed analyses of the bottom organisms.



Dredge being emptied into tub preparatory to straining sample.

poundment; Cane River Lake, an old river lake; and Lake Providence, a Mississippi River Oxbow lake. Only four lakes were set up in the study due to limited funds.

The study consists of four major segments, including the analyses of water chemistry samples, plankton samples, bottom fauna samples, and fish population samples. Plankton are the small plants and animal organisms which float free in the water and are usually microscopic. The bottom fauna are those organisms which live on the bottom of lakes, including the immature phases of such species as the dragon fly, damsel fly, and midge fly. Both bottom fauna and plankton are consumed by fish as food and therefore contribute to the fish production of a lake. The chemistry of the water has a definite effect on the extent of the production of these small invertebrate animals, so this is the first link in the chain.

It is hoped that eventually we will be able to correlate these factors in determining what our lakes are capable of producing in the way of sport and commercial fish. The results of such a study will certainly contribute to the future management principals employed by the fresh water fishery section of this Department.

Sieve is washed to remove mud and silt from sample.

DINGELL-JOHNSON PROJECT F-5R EVALUATION OF COMMERCIAL FISHING GEAR

James T. Davis
Project Leader

Lloyd E. Posey
Assistant Project Leader

Commercial fishing is and will remain, with careful management, a very important industry in the state of Louisiana. Freshwater commercial fisheries are beset with many detractors. Not the least of these is a conflict with sport fisheries in the minds of many of the sport fishermen. This is not only unnecessary, but is unfounded. In 1954 the Louisiana legislature requested that the fisheries section of the Louisiana Wildlife and Fisheries Commission investigate this problem and make recommendations for its alleviation. The result of this request was the initiation of Dingell-Johnson Project F-5R.

The answer to such a complex problem can be derived only through the results of much fishing and much study. Accordingly cotton, linen and nylon nets were fished. These included hoop nets, gill nets and trammel nets. In order to gain a more thorough insight into the problem wire traps and basket traps were constructed and fished. Throughout the project commercial fishermen were contacted and their catch tabulated and compared to the catch of project nets. Without exception the commercial fishermen took fewer sport fish than were captured by the project nets.

Certain nets merit special attention and comment. Wire traps of one inch mesh were extremely effective in capturing sport fish. Basket traps were very selective in the taking of catfish. Mesh size had little effect on the number of sport fish taken by wire traps. By varying the distance between slats in basket traps both the numbers and sizes of catfish taken changed. This will be more fully discussed later.

The determination of proper mesh sizes is not so easily realized. Excessive cropping of commercial fish would leave no seed stock for continuation of the fishery. Contrary to popular belief few sport fish are caught in two inch mesh nets, especially hoop nets. The smaller the mesh size, the more the number of trash fish, such as shad, that are removed from the body of water. Buffalo fish are caught usually in rather large mesh open nets. Catfish are more often taken in very small mesh "dark" nets. These and many other problems affect the recommendations and final decisions as to a best mesh size for the state of Louisiana as a whole.

Before discussing any of these problems further a presentation of data taken by commission personnel during the past three years is in order. These data were collected from all fish caught in commission owned and operated nets throughout the state. The thirty-two representative areas fished were as follows,

Ouachita River—
Red River—
Black River—
Mississippi River—
Tchefuncta River—
Bogue Falaya River—
Tickfaw River—
Tangipahoa River—
Pearl River—
Atchafalaya River—
Amite River—
Comite River—
Morganza Spillway—
Bayou D'Arbonne—
Bayou Bartholomew—
Bayou Courtableau—
Black Bayou Lake (Ouachita Parish)—
Black Bayou Lake (Caddo Parish)—
Bayou DeSiard—
Caddo Lake—
Black Lake (Natchitoches Parish)—
Lake Bistineau—
Lake Providence—
Chicot Lake—
Lake Bruin—
Bartholomew Lake—
Raccourcii Lake—
Port Sulfur Lakes—
Clear Lake (Caddo Parish)—
Davis Lake—
Colyell Bay—
Grays Bay—

Nets from one to four inch bar measure (two to eight inches stretched) were fished. A portion of this data is presented below. Limitations of space prevent the presentation of the data in its entirety.

CATCH OF ONE INCH MESH WIRE TRAPS IN 1828 NET DAYS[1]

	Number/ Net Day	Pounds/ Net Day	Percent of Total No.
Commercial fish	0.19	0.17	7.28
Sport fish	2.33	0.51	85.97
Predatory fish[2]	0.18	0.60	6.67
Forage fish[3]	T	T	0.08
Grand Total	2.70	1.28	100.00

CATCH OF ONE INCH MESH HOOP NETS IN 353 NET DAYS[1]

Commercial Fish	0.81	1.00	31.75
Sport fish	0.85	0.37	33.17
Predatory fish	0.33	1.57	12.92
Forage fish	0.56	0.35	22.16
Grand Total	2.55	3.29	100.00

CATCH OF ONE AND ONE-HALF INCH MESH HOOP NETS IN 517 NET DAYS[1]

Commercial fish	0.23	0.36	20.09
Sport fish	0.54	0.33	47.14
Predatory fish	0.11	0.66	10.10
Forage fish	0.27	0.19	22.67
Grand Total	1.15	1.54	100.00

CATCH OF TWO INCH MESH HOOP NETS IN 646 NET DAYS[1]

Commercial fish	0.45	1.08	54.60
Sport fish	0.08	0.10	11.02
Predatory fish	0.10	0.79	13.08
Forage fish	0.17	0.17	21.30
Grand Total	0.80	2.14	100.00

CATCH OF TWO AND ONE-HALF INCH MESH HOOP NETS IN 1713 NET DAYS[1]

	Number Net Day	Pounds/ Net Day	Percent of Total No.
Commercial fish	0.31	1.04	80.65
Sport fish	T	T	0.75
Predatory fish	0.05	0.63	11.55
Forage fish	0.03	0.04	7.05
Grand Total	0.39	1.71	100.00

CATCH OF A TWO INCH MESH GILL NET MADE WITH 139 NYLON IN 105 NET DAYS[1]

	Number/ Net Day	Pounds/ Net Day	Percent of Total No.
Commercial fish	2.47	5.25	17.93
Sport fish	2.71	2.63	19.73
Predatory fish	1.92	9.17	13.97
Forage fish	6.63	6.42	48.37
Grand Total	13.73	23.47	100.00

CATCH OF A TWO AND ONE-HALF INCH MESH NET MADE WITH 139 NYLON IN 80 NET DAYS[1]

Commercial fish	1.83	4.92	45.34
Sport fish	0.99	1.86	24.53
Predatory fish	0.20	1.37	4.97
Forage fish	1.01	1.54	25.16
Grand Total	4.03	9.69	100.00

CATCH OF A THREE INCH MESH GILL NET MADE WITH 139 NYLON IN 102 NET DAYS[1]

Commercial fish	0.68	3.71	59.66
Sport fish	0.22	0.47	19.29
Predatory fish	0.11	0.84	9.65
Forage fish	0.13	0.19	11.40
Grand Total	1.14	5.21	100.00

CATCH OF A FOUR INCH MESH GILL NET MADE WITH 139 NYLON IN 80 NET DAYS[1]

	Number/ Net Day	Pounds/ Net Day	Percent of Total No.
Commercial fish	1.12	10.57	84.26
Sport fish	—0—	—0—	—0—
Predatory fish	0.18	2.23	13.89
Forage fish	0.02	0.01	1.85
Grand Total	1.32	12.81	100.00

CATCH OF A FOUR AND ONE-HALF INCH MESH GILL NET MADE WITH 277 NYLON IN 178 NET DAYS[1]

	Number/ Net Day	Pounds/ Net Day	Percent of Total No.
Commercial fish	0.43	5.24	86.20
Sport fish	—0—	—0—	—0—
Predatory fish	0.06	0.59	12.65
Forage fish	0.01	0.01	1.15
Grand Total	0.56	5.84	100.00

CATCH OF TWO INCH MESH TRAMMEL NET IN 132 NET DAYS[1]

	Number/ Net Day	Pounds/ Net Day	Percent of Total No.
Commercial fish	4.20	9.16	25.70
Sport fish	4.61	5.16	28.15
Predatory fish	1.62	8.16	9.79
Forage fish	5.95	6.48	36.36
Grand Total	16.38	28.96	100.00

CATCH OF TWO AND ONE-HALF INCH MESH TRAMMEL NETS IN 161 NET DAYS[1]

	Number/ Net Day	Pounds/ Net Day	Percent of Total No.
Commercial fish	1.47	4.60	29.22
Sport fish	2.26	3.95	44.85
Predatory fish	0.48	3.38	9.71
Forage fish	0.82	1.21	16.22
Grand Total	5.03	13.14	100.00

CATCH OF THREE INCH MESH TRAMMEL NET IN 59 NET DAYS[1]

	Net Day	Net Day	Total No.
Commercal fish	0.19	1.07	68.75
Sport fish	0.04	0.10	12.50
Predatory fish	0.06	0.57	18.75
Forage fish	—0—	—0—	—0—
Grand Total	0.29	1.74	100.00

CATCH OF THREE AND ONE-HALF INCH MESH TRAMMEL NETS IN 197 NET DAYS[4]

	Number/ Net Day	Pounds/ Net Day	Percent of Total No.
Commercial fish	0.33	2.66	79.74
Sport fish	0.05	0.09	12.66
Predatory fish	0.03	0.26	6.33
Forage fish	0.01	—0—	1.27
Grand Total	0.42	4.01	100.00

CATCH OF FOUR INCH MESH TRAMMEL NETS IN 184 NET DAYS[1]

	Number/ Net Day	Pounds/ Net Day	Percent of Total No.
Commercial fish	0.21	2.53	88.64
Sport fish	0.02	0.08	6.82
Predatory fish	0.02	0.06	4.54
Forage fish	—0—	—0—	—0—
Grand Total	0.25	2.67	100.00

Before recommending a mesh size for nets to be used in taking commercial fish certain things must be considered. The harvest of the commercial species must be perpetual. Nets or mesh sizes must be large enough to allow sufficient stock to remain to spawn. Buffalo fish spawn at about sixteen inches in length or at a weight of two pounds. Therefore nets should allow at least a portion of this size of fish to escape capture. At the same time channel catfish spawn at 13.5 to 14 inches or about 1.5 pounds. The net that would take a portion of these catfish would take very small buffalo before they reached spawning size. To the contrary, the net that would take buffalo would let most catfish escape.

The habits of catfish differ greatly from buffalo. Catfish will enter a small mesh dark net quite readily. Buffalo usually will shy away from such a net. Instead buffalo enter very open clear nets. This is probably due to the preference of the catfish for logs while the buffalo remain in open water.

Trash fish, such as shad, cause considerable problems in many lakes in Louisiana. They soon overpopulate a lake and then compete with the sport fish for nutrients. The removal of these fish may be done in several ways. Commercial fishermen would remove many shad in the course of their netting. This would be the most economical method of removal. Another method would be to hire crews to seine or otherwise remove the shad. This is expensive, but sometimes the only method possible. If commercial fishermen are allowed to fish only large mesh nets shad overpopulations must be removed by one of the more expensive methods.

Sport fishing is big business in the state of Louisiana. Stop at any stream or lake and count the cost of putting all the boats on the water. Add the cost of fishing equipment, gasoline and food to bring people to the area, and the expensive added gear such as boat cushions, etc. All in all, the people and merchants of Louisiana profit greatly from this sport. Therefore, all of these factors should be taken into consideration in establishing regulations governing commercial fishing gear.

As can be seen by the accompanying tables wire nets of the type used in this investigation take few commercial fish and many sport fish. Other states with other designs for wire nets have had better success. These are being investigated by the Wildlife and Fisheries Commission.

Hoop nets form a special group and will be treated as such. From two inch mesh on up the commercial fish make up the major portion of the catch. However, a goodly number of the buffalo captured in two inch mesh nets were undersized. Most catfish taken were of legal sizes. Sport fish occupied a very low percentage of the total catch. Shad would be removed in goodly numbers by this mesh sized net. At two and one-half inches, all buffalo were of commercial sizes and few sport fish were taken. Few shad would be removed by these nets.

Trammel and gill nets catch fish by entanglement. The accompanying tables show that from two inch mesh on up sport fish would not be taken in large quantities. To get maximum shad removal two inch mesh nets would give the best results. Three inch mesh nets permit the escapement of most undersized buffalo while smaller mesh nets do not. Very few catfish are caught in such a large mesh net however.

[1] A net day is one net fished for 24 hours.
[2] Includes all gar and bowfin.
[3] Includes shad and other trash fish.
[4] A net day is 100 yards of net 8 feet deep fished 24 hours.
T = Trace.

Therefore, if three inch mesh nets are to be used, another method must be used to capture catfish.

Catching catfish efficiently seems to require a dark net or trap. The basket or slat trap fits this requirement. Furthermore, it takes few sport fish. Though presently illegal in this state, it is in use by many surrounding states. With the data now available it appears that the use of basket traps would permit the effective cropping of catfish in the state. If the opening between slats was set at two inches, no detrimental effect on the fishery would be felt. With these things in mind the following recommendations for changes in freshwater commercial fishing laws are made:

1. Hoop nets be limited to two and one-half inch mesh bar measure.
2. Gill nets, trammel nets, and seines be limited to three inch mesh bar measure.
3. Wood basket or slat traps with a two inch opening between slats be legalized.
4. That size limits be removed on buffalo and drum (gaspergou).
5. That the Louisiana Wildlife and Fisheries Commission be empowered to set or remove size limits on all fresh water commercial fish.

DINGELL-JOHNSON PROJECT F-4R FISH POPULATIONS AND AQUATIC CONDITIONS IN POLLUTED WATERS

James T. Davis
Project Leader

In the face of booming industrialization in the south, it is imperative that accurate reliable data on the effects of industrial wastes on aquatic flora and fauna be compiled. Encroachment of industries on the economic, biological, and aesthetic values of streams must be halted before they become too firmly entrenched to be dislodged.

The problem of pollution in Louisiana, while under excellent control and subject to ample laws, is still far from solved. The use of chemical data has proven insufficient for the formulation of policies for pollution abatement. It is becoming increasingly apparent that pollutional effects upon biological specimens must also be taken into account. These effects must be thoroughly understood, both from the immediate results and the long term trends. This implies a knowledge of the relationship and interaction of several types of pollutants.

Fish are the normal end products of aquatic production; therefore, studies should be initiated and continued to determine the relationship between fishes and pollution. This necessitates a study of fish foods as well as the innate habits of fishes. Project F-4R was set up to accumulate this type of biological data. The recommendations made will prove extremely valuable to the Louisiana Wildlife and Fisheries Commission and the surrounding states as well.

The Ouachita River, including certain tributaries and adjoining lakes, was selected for this study and was based on two reasons. The waters are of general importance in the study of sport and commercial fish. In addition the river is subject, in part, to various types of generally important waste discharges.

In the past the Ouachita River system has supported an extensive sport fishery. In certain areas it still enjoys periodic heavy fishing. Commercial fishing, though on the decline for years, has had a definite importance in contributing to the general economy. Wastes that are dumped into the Ouachita and are of general importance are several in number. Of greatest importance are paper mill wastes, chemicals from chemical manufacture, and oil and gas field wastes. All of these have been responsible for large quantities of fish being destroyed since the initiation of the project. Another pollutant of very dubious character is domestic sewage discharge.

In order to obtain the broad objectives of this project, work has been catagorized under several jobs. The objectives of these individual jobs has been discussed in the Sixth Biennial Report. A discussion of the accomplishments of the various jobs is presented below.

Fish Population Study

Fish are the end products of aquatic production. Pollution has definite effects on this production. Frequently the effects are felt in the form of reduced food, destruction of habitat, or removal of spawning areas. Sampling fish populations gives us an indication of the final effects. Other investigations lead us to understand the how of the effects.

By sampling fish populations we determine the sport fish/commercial fish ratio. Further, we are able to determine the total production. This enables us to tell if the total population is affected adversely or just certain species. Some fish must have clean water in which to live. Other fishes can survive under polluted conditions. This may be due either to the removal of predaceous species or to better growing conditions. Data on this phase of the investigation leads to the conclusion that the entire Ouachita fish population has been reduced by pollution.

Size and Age Group Study

The ultimate objective of this job is to determine the size and age group composition of the predominant sport fishes in the Ouachita River. Data which has been taken on lengths and weights are compared to similar unpolluted waters. This enables us to determine the age at which fish enter the creel in polluted waters as compared to non-polluted waters. As yet no conclusions have been drawn from the data gathered. One major stumbling block is the inability of people to tell how long the fish has been in polluted waters prior to his capture.

Fish Food and Food Habits Study

These two studies are closely related. In the former, the availability of food is studied. In the latter, the preference for certain foods of fish are studied. With data collected from both studies it is possible to determine whether pollution drives fish from an area or the shortage of food (caused by pollution) starves them out of an area. Most fish feed to a large extent on bottom dwelling organisms (called benthos). Pollutants often kill these organisms without otherwise bothering the fish. The production of benthos is checked at thirty (30) locations on the Ouachita quarterly. From these collections it has been possible to confirm areas of suspected pollution. In addition it has been possible to explain the low fish production in certain areas from these studies. Catfish feed largely on snails and clams. These do no occur in heavily polluted areas. Therefore, low numbers of catfish live in those areas. Other fish such as bluegill feed on midge larvae. They prefer certain types which do not occur in polluted areas. Therefore, they leave an area where these types are absent.

Reproduction Study

This study, though extremely important, has failed to produce any conclusive evidence at this time. Several factors affect the reproduction of fishes. Adequate suitable spawning areas is not the least of these. This problem can be assayed rather easily. Not so easy is how to determine how long a fish must remain in polluted water before he cannot or will not spawn. After a fish spawns the eggs may not hatch or the water may be so polluted that young fishes cannot live.

During the past year spawning was excellent. Young fish appeared in exceedingly large numbers. This was due largely to high waters which kept pollutants diluted to a non-toxic level. If this low level of toxicity is maintained either by high water levels or treated non-toxic waste disposal, fish reproduction should remain high.

Fish Migration and Management Study

Many fish migrate upstream to spawn. If pollutional barriers exist the migration will not take place and spawning will be curtailed. In this study fish are tagged and then released to be recaptured on the spawning grounds. Data collected to date has indicated that due to high water levels at spawning time pollutants are so diluted as to form no barrer to migrant fishes.

Movement of fishes often occurs at other times of the year to escape undesirable conditions. During these times it is entirely possible that pollutional barriers are present which inhibit movement. This possibility is still being investigated. In addition to the objectives of this job considerable data is being collected as to fish population dynamics in the state.

Bioassays

This phase of the investigation, though new, has already shown us how much of certain pollutants can be in the water before becoming toxic. All pollutants that are found in the area are being tested. From the data thus obtained it is possible to determine exactly how much of a pollutant can be dumped into a body of water without adverse effects.

Taste and Odor Analyses

Off flavors in fish often cause their rejection from the frying pan. This study is set up to determine how long a fish may remain in water polluted by any of several means before acquiring an objectionable odor or taste. It is hoped that the mechanism by which this odor is obtained may also be determined and possible corrective measures applied to the polluting agent.

Chemical Studies

Chemical data are generally recognized as insufficient in the determination of effects of pollutants. They are not sufficient for intelligent pollution abatement. The chemical contents of both the pollutant and the receiving waters are extremely important. From these tests it is possible to determine the duration and extent of a pollutant.

This study in conjunction with the others contained in the project give a close indication of the extent of pollution on the Ouachita. From this study recommendations for further pollution abatement should soon be forthcoming.

Biologist measures free carbon dioxide during field water chemistry analyses of lake water.

DINGELL-JOHNSON PROJECT F-1-R

FISH POPULATION INVESTIGATION

VICTOR LAMBOU
Project Leader

HERB STERN
Assistant Project Leader

On April 1, 1953, Dingell-Johnson Project F-1-R (Fish Population Investigations) was initiated in order to gather basic information needed to plan a constructive sport fish management program. The Fifth and Sixth Biennial Reports covered the progress of the project through December 31, 1955.

During this biennium, considerable progress was made in realizing the project's objectives. Much of the project's findings have been reported in the form of progress reports. The following project reports were prepared during the biennium:

1. University and City Park Lakes Fisheries Investigations
2. Evaluation of Lake Bistineau Gill Net Fishery and Comments Relative to Proposal to Close the Lake to Commercial Fishing
3. Preliminary Report on Chemical and Physical Data Collected from Lake Bistineau by Dingell-Johnson Project F-1-R
4. Preliminary Report on Results of Rotenone Samples of Fish Populations Taken from Lake Bistineau by Dingell-Johnson Project F-1-R
5. Conditions of Some Fishes from Lake Bistineau
6. Job Completion Report—Statewide Creel Census
7. Job Completion Report—Determination of Growth Rate of Young of the Year Largemouth Bass, Black Crappie and White Crappie
8. Job Completion Report—Creel Census
9. Job Completion Report—Tagging Study
10. Job Completion Report—Comparison of Estimated Age and Growth of Fish with Their Known Age and Growth
11. Preliminary Report on Sample Size in Rotenone Sampling of Fish Population
12. Preliminary Report on Sample Size in Rotenone Sampling of Fish Populations—Supplement No. 1
13. Preliminary Report on Fish Populations Occurring in Some of the Streams on the Red Dirt Game Management Area, Natchitoches Parish, Louisiana
14. Preliminary Report on the Catch of Wire Traps Fished in Lake Bistineau, Bayou Dorcheat and Clark's Bayou
15. Comparison of the Catch of Wire Traps Fished in Different Locations on Lake Bistineau
16. The Relationship of Density of Cover to the Catch of Wire Traps Fished in Lake Bistineau
17. Comparison of the Catch for Different Types of Sets of Wire Traps in Lake Bistineau
18. The Relationship of Depth of Water to the Catch of Wire Traps Fished in Lake Bistineau
19. Comparison of the Catch for Baited and Unbaited Sets of Wire Traps in Lake Bistineau
20. The Relationship of Clearness of the Water to the Catch of Wire Traps Fished in Lake Bistineau

21. Preliminary Report on Fish Populations Occurring in Louisiana Backwater Lakes
22. Preliminary Reports on Fish Populations Occurring in Louisiana Impoundments
23. Preliminary Report on Fish Populations Occurring in Mississippi River Oxbow Lakes in Louisiana
24. Observations Relative to the Effects of Pumping Water into Clear Lake, Richland Parish, Louisiana

The data contained in the above mentioned reports are much too complex and numerous to be given in their entirety in a report of this nature. Therefore, only a brief summary of some of the more important findings will be presented. The reader who desires more detailed information is referred to the progress reports.

Two technical papers were given by the project leaders at the Technical Fish Session of the 11th Annual Conference of the Southeastern Association of Game and Fish Commissioners at Mobile, Alabama. These papers are as follows:

1. An Evaluation of Some of the Factors Effecting the Validity of Rotenone Sampling Data
2. Some Uses of Punch Card Methods in the Tabulation and Analysis of Fishery Research Data

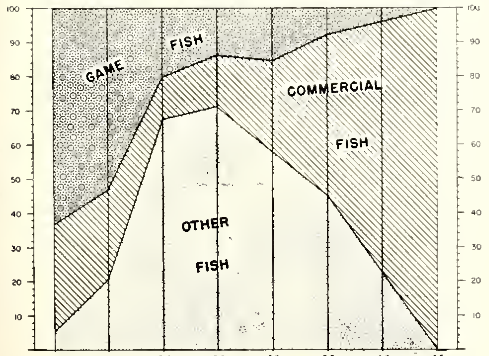
The second paper was a joint contribution from the Remington Rand Division of Sperry Rand Corporation and Project F-1-R. Mr. Ben Leeper of the Remington Rand Corporation co-authored the report with the project leaders.

A summary of some of the project's findings follow:

Evaluation of Lake Bistineau Gill Net Fishery and Comments Relative to Proposal to Close the Lake to Commercial Fishing

The data and comments presented here are relative to the proposal to close Lake Bistineau to commercial fishing. The types of commercial gear used on Lake Bistineau are gill nets, trammel nets and hoop nets. Hoop netting is not done in the lake proper, but in the tributary streams during periods of high flow. The majority of the commercial fishing done on the lake proper is with gill nets, and therefore, only the gill net fishery will be considered here.

In order to determine the efficiency of gill nets in catching game fish, gill nets were fished experimentally in Lake Bistineau. Gill nets used were 175 yards long and 8 feet deep, and consisted of 25 yards of the following mesh sizes: 1.0, 1.5, 2.0, 2.5, 3.0, 3.5 and 4.5 inch square mesh. Each net set was fished approximately 24 hours, and samples were taken at different depths and in all types of habitat occurring in the lake. Four samples were taken during the month of March, 24 samples were taken during the month of April, 20 during May, 10 during June, 7 during July and 5 during August for a total of 70 net samples during 1956.



* Values for 4.0 inch mesh size were interpolated.

Fig. 1—Percent game fish, commercial fish, and other fish caught in various mesh sizes of nylon gill nets fished in Lake Bistineau.*

Game fish were numerous in the catch of the small mesh gill netting, especially in the 1.0, 1.5 and 2.0 inch mesh netting; however, the rate of catch decreased in the 2.5 inch mesh netting with the exception of black crappie. Very few game fish were caught in the 3.0, 3.5 and 4.5 inch mesh gill netting.

Game fish composed over 50 percent of the catch in 1.0 and 1.5 inch mesh gill netting. The percentage of game fish in the catch decreased as the size of the mesh increased. Game fish made up a very small portion of the catch of 3.5 and 4.5 inch mesh netting (Fig. 1).

Largemouth bass, chain pickerel, yellow bass, black crappie, bluegill sunfish, redear sunfish and warmouth sunfish were the principle game species caught.

Largemouth bass were most numerous in the catch of the 1.0, 1.5, 2.0 and 2.5 inch mesh gill netting (0.1, 0.2, 0.2 and 0.1 fish per net day respectively). Less than .05 fish per net day were caught in the 3.0 inch netting and no fish were caught in the larger mesh sizes. It is probable that most largemouth bass under 20 inches in length are too small to be caught in netting 3.0 inches and larger. Most bass in the fish population in Lake Bistineau are smaller than 20 inches in length; and therefore, it is concluded that 3.0 inch and larger mesh gill netting will catch very few largemouth bass in Lake Bistineau.

Chain pickerel were numerous in the 1.0 and 1.5 inch mesh gill netting (0.3 and 0.2 fish per net day). The catch was less than 0.05 fish per net day in the 2.0 inch mesh netting and no fish were caught in the larger mesh sizes. Probably most pickerel under 20 inches in length are too small to be caught in 2.0 inch and larger mesh size netting. The majority of the pickerel in the population are smaller than 20 inches in length, which explains the low catch of pickerel in 2.0 inch and larger mesh gill netting.

Yellow bass were most numerous in the catch of the 1.0, 1.5, 2.0 and 2.5 inch mesh gill netting (0.2, 1.4, 0.4 and 0.1 fish per net day respectively). No yellow bass were caught in the 3.0 inch and larger mesh netting. Considering the abundance of the yellow bass in the population, gill nets of less than 3.0 inch mesh netting were very efficient in catching yellow bass.

Black crappie were numerous in the 1.0, 1.5, 2.0, 2.5 and 3.0 inch mesh netting (0.2, 0.3, 0.3, 0.3 and 0.1 fish per net day respectively). They were not numerous in the mesh sizes larger than 3.0 inches. Only crappie approximately 14 inches and larger were caught in the 3.0 inch and larger mesh gill netting. Very few crappie in the population are 14 inches and longer.

Sunfishes—bluegill, redear and warmouth—were most numerous in the 1.0, 1.5 and 2.0 inch mesh netting. Practically no sunfishes were caught in the 2.5 inch and larger mesh gill netting. The 2.5 inch mesh netting caught sunfish approximately 9-10 inches and larger in length. Very few sunfishes over 10 inches in length occur in the fish population.

The catch of commercial species in gill nets fished in Lake Bistineau were rather low. Commercial fish, especially those preferred by the fishermen, made up a larger percent of the catch of the larger mesh netting (3.5 and 4.5 mesh) than the smaller mesh netting.

Gizzard shad was the only other species of fish numerous in the gill net samples. They were most prevalent in the 1.0, 1.5, 2.0, 2.5 and 3.0 inch mesh netting; in fact in many cases gizzard shad were the most numerous fish caught.

A lake can only support so many fish, depending upon the amount of food available for the fish. This fish population can be made up primarily of game species or of non-game species. Any reduction in the abundance of non-game species will result in an increase in the abundance of game species. The removal of a substantial portion of the shad population in a North Louisiana Lake where experimental fishery management experiments were conducted, resulted in approximately a five-fold increase in the number and pounds of game fish harvested by sport fishermen. Commercial fishing can in some instances prevent non-game fish from becoming overabundant in a lake. Therefore, commercial fisheries are often beneficial to the sport fisheries. Even if commercial fishing does not control the abundance of non-game species in Lake Bistineau, it would allow for the utilization of a resource that would otherwise be wasted.

Gill nets of 3.0 inches and larger mesh sizes caught very few game species. Probably the main reason for this is that the majority of game fish present in the fish population are not of a large enough size to be caught in the larger mesh sizes.

The most valuable commercial fish caught in gill nets in North Louisiana are buffalo fish. Nine pounds and larger buffalo fish are sold for premium prices on the market and therefore are most in demand. Gill nets of smaller mesh size than 3.0 inches catch rather small size buffalo fish.

Gill nets of 2.0 inches mesh size and larger are legal to fish in Lake Bistineau. Taking into consideration the size of buffalo fish caught and the take of game fish in the smaller mesh sizes, it is recommended that consideration be given to raising the legal mesh size to 3.0 inches in Lake Bistineau. This would certainly eliminate most of the catch of game fish in gill nets.

It should be pointed out that there is no evidence that the catch of game species by legal gill nets of smaller mesh size than 3.0 inches (2.0-2.9 inches) is detrimental to the sport fishery on Lake Bistineau. Probably most of the commercial fishermen do not keep game fish caught in their nets; however, some do as demonstrated by the fact that rangers of the Enforcement Division, on four separate occasions during the spring of 1956, made arrests for the illegal possession of game fish caught in gill nets. At the rate game fish were captured by the gill nets, it would take a tremendous amount of gill net fishing to have any effect on the abundance of game fish in the lake, especially considering the total population of fish present in the lake.

Based on the information presented here, no reasons can be seen for closing Lake Bistineau to commercial fishing. However, consideration should be given to the possibility of raising the minimum mesh size for gill nets to 3.0 inches.

Chemical and Physical Data Collected from Lake Bistineau

Chemical and physical data were collected from 5 sampling stations on Lake Bistineau. Some of these data are summarized here. Table 1 summarizes salinity determinations from the lake. Table 2 shows turbidity and pH readings made at various sampling stations.

Temperature readings were taken at varying depths from the five sampling stations. These data are shown in Figures 2 through 6. From the data collected, indications are that summer thermal stratifications during the study period were incomplete or only temporary in nature. True stratification, as set forth by Berge, states that ". . . where the fall in temperature with increasing depth from the surface is less than 1°C per m. (0.548°F. per ft.) that position is still within the epilimnion: but where the temperature decline becomes 1°C. per m. of depth, that circumstance marks the upper limit of the thermocline; and finally, the lower limit of the thermocline is similarly determined. . ., where the drop in temperature with increasing depth first becomes less than 1°C per m."

TABLE No. 1

Salt concentrations (expressed as NaCl p.p.m.) at various stations on Lake Bistineau.

Sampling Station								
Clark Bayou Bridge			Smokey's Camp			Jimmy Dugan's Camp		
	NaCl p.p.m.			NaCl p.p.m.			NaCl p.p.m.	
Date	Top	Bot.	Date	Top	Bot.	Date	Top	Bot.
4- 8-56	198	259	4- 8-56	1378	1378	4- 8-56	188	165
4-16-56	403	414	4-16-56	281	281	4-17-56	205	193
5- 4-56	309	263	5- 4-56	177	172	5- 5-56	131	263
5-17-56	312	501	5-17-56	230	230	5-17-56	246	246
6- 7-56	320	336	6- 7-56	263	246	6-16-56	263	263
6-16-56	361	673	6-16-56	263	......			
			7-24-56	312	295			

Sampling Station							
Shady Point			Grice's Camp			Bubbling Well	
	NaCl p.p.m.			NaCl p.p.m.		June, 1956	
Date	Top	Bot.	Date	Top	Bot.	Loc.	NaCl p.p.m.
4-12-56	121	127	4-12-56	231	221	Water out of well itself	361,548
4-17-56	121	132	5- 3-56	177	193		
5- 5-56	213	328	5-17-56	164	188	20 ft. from well, shallow water	312
5-17-56	263	246	6- 7-56	164	205		
6- 7-56	263	263	6-16-56	164	180		
			7-24-56	180	......	150 yds. from well, at surface depth	197
						150 yds. from well, at bottom depth 6 ft.	427

TABLE No. 2

Turbidity (expressed as Secchi Disk Readings, in feet) and pH at various stations on Lake Bistineau.

Clark Bayou Bridge				Smokey's Camp				Jimmy Dugan's Camp			
		pH				pH				pH	
Date	Disk Reading	Top	Bottom	Date	Disk Reading	Top	Bottom	Date	Disk Reading	Top	Bottom
3-14-56	0.67	6.4	6.4	3-14-56	1.25	6.0	6.0	3-16-56	8.17	6.0	5.9
4- 8-56	1.38	6.2	6.2	4- 8-56	1.00	6.1	6.1	4- 8-56	2.17	6.1	6.1
4-16-56	1.79	6.5	6.4	4-16-56	2.00	6.2	6.3	4-17-56	3.50	6.0	6.0
5- 4-56	0.96	6.4	6.4	5- 4-56	1.08	6.3	6.3	5- 5-56	6.17	6.2	6.0
5-17-56	3.08	6.6	6.5	5-17-56	1.75	6.4	6.4	5-17-56	5.04	6.4	6.4
6- 7-56	3.92	6.8	6.7	6- 7-56	2.92	7.1	6.8	6-16-56	4.42	6.6	6.5
6-16-56	2.92	7.1	6.6	6-16-56	3.00	7.1	6.5	7-24-56	4.83	6.7	6.6
7-25-56	7.33	6.7	6.6	7-24-56	3.50	7.1	6.6				

Shady Point				Grice's Camp			
		pH				pH	
Date	Disk Reading	Top	Bottom	Date	Disk Reading	Top	Bottom
3-16-56	3.38	6.2	6.2	3-16-56	6.33	6.2	6.2
4-12-56	2.00	6.2	6.2	4-12-56	6.67	6.4	6.4
4-17-56	2.25	6.3	6.3	4-17-56	5.83	6.6	6.4
5- 5-56	5.92	6.5	6.5	5- 3-56	7.42	6.6	6.2
5-17-56	4.21	6.6	6.4	5-17-56	4.21	6.9	6.6
6- 7-56	5.83	6.6	6.4	6- 7-56	3.67	7.2	6.9
7-25-56	3.50	6.8	6.6	6-16-56	3.17	6.7	6.9
				7-24-56	3.17	6.9	6.8

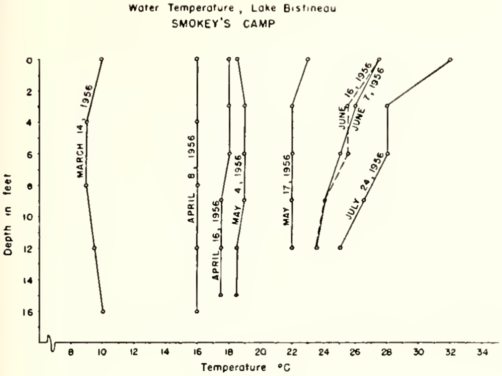


Fig. 2—

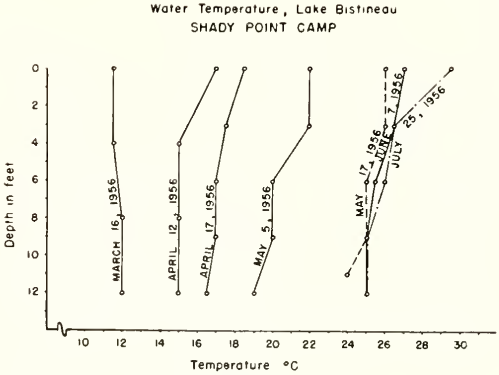


Fig. 5—

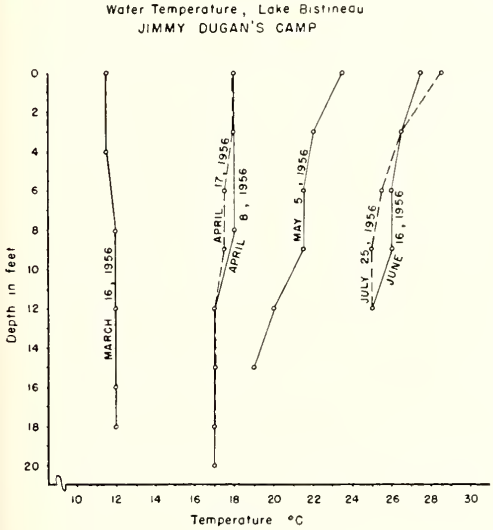


Fig. 3—

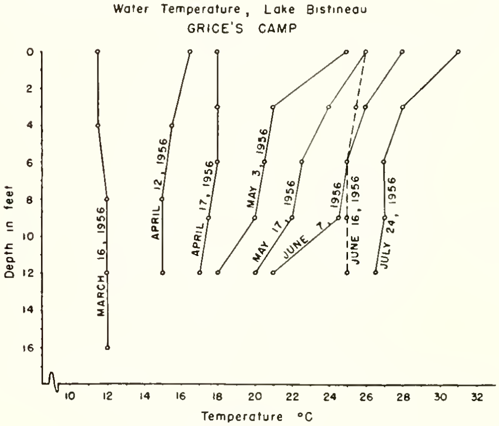


Fig. 6—

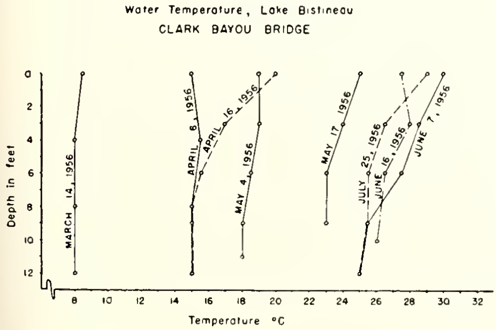


Fig. 4—

Rotenone Sampling of Fish Populations Occurring in Lake Bistineau

In order to gather detailed information on the fish population occurring in Lake Bistineau, eighteen-one acre rotenone samples of the fish population were taken during the late summer and early fall of 1955. The following grouping of the samples were made for summary purposes:

Sample Group No. 1—includes all samples taken from upper third of the lake.

Sample Group No. 2—includes all samples taken from middle portion of the lake.

Sample Group No. 3—includes all samples taken from lower third portion of the lake.

Sample Group No. 4—includes all samples taken from old drowned Bayou Dorcheat Channel—this includes samples taken from the areas where, generally, the greatest depths of water occur.

Sample Group No. 5—includes all samples not taken from along the shoreline or from the old drowned Bayou Dorcheat Channel—this includes samples taken from the areas where, generally, medium depths of water occur.

Sample Group No. 6—includes all samples taken along the shoreline of the lake—this includes samples taken from the areas where, generally, the shallowest depths of water occur.

Sample Group No. 7—includes all eighteen samples.

The number and pounds of fish per acre occurring in the samples, by sample groups, are given in Tables 3 through 6, while Tables 7 through 10 give the number and pounds of fish by individual samples.

TABLE No. 3

Number of Fish Per Acre Occurring in Rotenone Samples Taken from Lake Bistineau

Kind of Fish	Sample Group Number						
	1	2	3	4	5	6	7
Non-Predaceous Fish	21,735.8	13,250.0	6,927.3	9,748.0	13,753.6	15,147.6	13,028.2
Bluegill Sunfish	2,413.3	1,957.3	1,516.8	476.8	1.040.0	4,741.6	1,911.8
Redear Sunfish	359.5	680.3	728.2	49.2	218.4	1,851.2	624.9
Longear Sunfish	5.3	1.6	....	....	2.6	2.6	1.9
Warmouth Sunfish	1,209.5	2,914.3	319.7	43.8	594.9	5,018.4	1,670.6
Stumpknocker Sunfish	114.8	44.5	224.7	65.4	16.6	340.6	120.2
Orangespotted Sunfish	2.0	9.1	10.3	1.4	.1	27.0	7.9
Small Sunfish	335.3	471.1	282.0	1.2	166.9	1,092.2	377.9
Hybrid Sunfish	.8	....	.2	.2	.4	....	.2
Pirate Perch	2 0	38.4	73.8	.4	.9	149.8	42.1
Gizzard Shad	133.8	56.5	74.8	60.4	110.1	50.6	79.8
Threadfin Shad	17,155.0	7,061.4	3,657.3	9,048.2	11,600.6	1,801.8	8,169.7
Drum	... ...	.1	1.5	.4	....	1.6	.6
Smallmouth Buffalo	....	.4	1.3	.2	....	2.0	.6
Lake Chubsucker	2.3	2.5	8.3	....	1.1	14.0	4.4
Yellow Bullhead	2.3	10.3	28.2	.4	.9	50.2	14.4
Eel	....	.3	.2	....	....	.6	.2
Madtom	. ...	2.1	....	....	....	3.4	.9
Golden Shiner	.3	....	....	....	.1	....	.1
Predaceous Fish	110.0	43.0	43.3	27.6	45.1	109.0	58.0
Largemouth Bass	34.8	24.3	23.2	10.4	15.3	59.6	26.2
Kentucky Bass	....	.3	.2	.2	....	.4	.2
White Crappie	....	....	.5	....	.3	.2	.2
Black Crappie	67.8	15.1	14.8	14.2	26.1	40.2	26.7
Yellow Bass	. ...	.4	1.7	1.6	.5	.2	.7
Chain Pickerel	4.8	2.6	1.7	.4	2.1	6.2	2.8
Longnose Gar	1.0	....	....	....	.5	....	.2
Shortnose Gar	. .....	....	1.0	....	....	1.2	.3
Spotted Gar	1.5	.3	.3	.6	.4	.8	.6
Yellow Catfish	.3	.1	....	.2	....	.2	.1
Total	21,845.8	13,293.0	6,970.7	9,775.6	13,798.8	15,256.6	13,086.2
Gamefish	4,547.5	6,120.8	3,123.8	664.8	2,084.0	13,180.4	4,772.2
Available Gamefish	151.5	71.0	85.2	83.6	90.6	108.4	93.6
Commercial Fish	7.3	13.6	40.7	1.8	2.9	70.0	21.2
Available Commercial Fish	7.3	13.6	40.7	1.8	2.9	69.8	21.2

TABLE No. 4

Percent of Total Number of Fish Occurring in Rotenone Samples Taken from Lake Bistineau

Kind of Fish	Sample Group Number						
	1	2	3	4	5	6	7
Non-Predaceous Fish	99.5	99.7	99.4	99.7	99.7	99.3	99.6
Bluegill Sunfish	11.1	14.7	21.8	4.9	7.5	31.1	14.6
Redear Sunfish	1.7	5.1	10.4	.5	1.6	12.1	4.8
Longear Sunfish	*	*	......	......	*	*	*
Warmouth Sunfish	5.5	21.9	4.6	.5	4.3	32.9	12.8
Stumpknocker Sunfish	.5	.3	3.2	.7	.1	2.2	.9
Orangespotted Sunfish	*	.1	.2	*	*	.2	.6
Small Sunfish	1.5	3.5	4.1	*	1.2	7.2	2.9
Hybrid Sunfish	*	......	*	*	*	......	*
Pirate Perch	*	.3	1.1	*	*	1.0	.3
Gizzard Shad	.6	.4	1.1	.6	.8	.3	.6
Threadfin Shad	78.5	53.1	52.5	92.6	84.1	11.8	62.4
Drum	......	*	*	*	......	*	*
Smallmouth Buffalo	......	*	*	*	......	*	*
Lake Chubsucker	*	*	.1	......	*	.1	*
Yellow Bullhead	*	.1	.4	*	*	.3	.1
Eel	.....	.1	*	......	......	*	*
Madtom	....	*	......	......	......	*	*
Golden Shiner	*	......	......	......	*	......	*
Predaceous Fish	.5	.3	.6	.3	.3	.7	.4
Largemouth Bass	.2	.2	.3	.1	.1	.4	.2
Kentucky Bass	......	*	*	*	......	*	*
White Crappie	......	......	*	......	*	*	*
Black Crappie	.3	.1	.2	.2	.2	.3	.2
Yellow Bass	......	*	*	*	*	*	*
Chain Pickerel	*	*	*	*	*	*	*
Longnose Gar	*	......	....	......	*	......	*
Shortnose Gar	. ....	......	*	. ...	....	*	*
Spotted Gar	*	*	*	*	*	*	*
Yellow Catfish	*	*	......	*	......	*	*
Total							
Game Fish	20.8	46.0	44.8	6.8	15.1	86.4	36.5
Available Game Fish	.7	.5	1.2	.9	.7	.7	.7
Commercial Fish	*	.1	.6	*	*	.5	.2
Available Commercial Fish	*	.1	.6	*	*	.5	.2

* Less than .05

TABLE No. 5

Pounds of Fish Per Acre Occurring in Rotenone Samples Taken from Lake Bistineau

Kind of Fish	Sample Group Number 1	2	3	4	5	6	7
Non-Predaceous Fish	187.5	74.2	104.1	78.0	116.8	128.7	109.3
Bluegill Sunfish	43.0	9.6	11.8	15.5	17.8	20.0	17.8
Redear Sunfish	5.0	11.7	13.9	8.0	7.4	19.5	10.9
Longear Sunfish	*	*	......	......	*	*	*
Warmouth Sunfish	7.3	2.3	3.3	1.9	2.5	7.6	3.8
Stumpknocker Sunfish	1.0	.3	1.0	.4	.3	1.7	.7
Orangespotted Sunfish	*	*	.1	*	*	.2	.1
Small Sunfish	.9	.8	.6	*	.5	2.1	.8
Hybrid Sunfish	.2	......	.1	.1	.1	......	.1
Pirate Perch	*	.2	.2	*	*	.5	.1
Gizzard Shad	11.5	16.6	37.6	17.7	14.4	40.1	22.5
Threadfin Shad	117.2	28.2	16.6	32.2	73.1	9.6	44.1
Drum	......	.4	5.0	.9	......	5.8	1.9
Smallmouth Buffalo	......	3.1	11.6	1.4	......	17.4	5.2
Lake Chubsucker	1.0	.5	1.9	......	.5	3.0	1.1
Yellow Bullhead	.3	.3	.4	*	.1	1.0	.3
Eel	......	.1	.2	....	......	.3	.1
Madtom	......	*	......	......	......	*	*
Golden Shiner	*	... ..	......	......	*	......	*
Predaceous Fish	36.2	4.4	7.9	10.3	13.3	14.0	12.6
Largemouth Bass	14.5	3.0	4.9	5.6	4.5	9.5	6.2
Kentucky Bass	......	.1	.1	.2	....	.2	.1
White Crappie	......	......	.2	......	.2	*	.1
Black Crappie	9.5	.3	.5	2.4	3.3	1.0	2.4
Yellow Bass	......	.1	.6	.9	*	*	.3
Chain Pickerel	3.8	.5	.1	.2	1.7	.9	1.1
Longnose Gar	6.1	......	......	......	3.1	......	1.4
Shortnose Gar	.... .	......	1.2	......	......	1.4	.4
Spotted Gar	1.8	.4	.3	.6	.5	.9	.7
Yellow Catfish	.6	*	......	.5	......	*	.1
Total	223.7	78.6	112.0	88.3	130.0	142.7	122.0
Game Fish	85.2	28.8	37.2	35.1	38.3	62.6	44.1
Available Game Fish	37.7	13.0	19.6	22.4	18.6	22.2	20.7
Commercial Fish	9.8	4.7	20.3	3.4	4.2	29.5	11.0
Available Commercial Fish	9.8	4.7	20.3	3.4	4.2	29.5	11.0

* Less than .05

TABLE No. 6

Percent of Total Pounds of Fish Occurring in Rotenone Samples Taken from Lake Bistineau

Kind of Fish	Sample Group Number 1	2	3	4	5	6	7
Non-Predaceous Fish	83.8	94.4	92.9	88.3	89.8	90.2	89.6
Bluegill Sunfish	19.2	12.2	10.5	17.6	13.7	14.0	14.6
Redear Sunfish	2.3	14.9	12.4	9.0	5.7	13.7	9.0
Longear Sunfish	*	*	......	......	*	*	*
Warmouth Sunfish	3.3	2.9	3.0	2.2	1.9	5.3	3.1
Stumpknocker Sunfish	.5	.4	.9	.4	.2	1.2	.6
Orangespotted Sunfish	*	*	.1	*	*	.1	*
Small Sunfish	.4	1.1	.6	*	.4	1.4	.6
Hybrid Sunfish	.1	......	*	.1	.1	......	.1
Pirate Perch	*	.2	.2	*	*	.4	.1
Gizzard Shad	5.1	21.1	33.6	20.0	11.1	28.1	18.4
Threadfin Shad	52.4	35.9	14.8	36.4	56.3	6.7	36.2
Drum	......	.5	4.5	1.0	......	4.1	1.5
Smallmouth Buffalo	......	3.9	10.3	1.6	......	12.2	4.3
Lake Chubsucker	.5	.6	1.7	......	.4	2.1	.9
Yellow Bullhead	.1	.4	.3	*	.1	.7	.3
Eel	.. ...	.1	.1	......	......	.2	.1
Madtom	......	*	......	......	....	*	*
Golden Shiner	*	.....	......	......	*	....	*
Predaceous Fish	16.2	5.6	7.1	11.7	10.2	9.8	10.4
Largemouth Bass	6.5	3.8	4.4	6.3	3.5	6.7	5.1
Kentucky Bass	......	.2	.1	.2	......	.1	.1
White Crappie	......	......	.2	......	.1	*	.1
Black Crappie	4.2	.4	.4	2 7	2.5	.7	2.0
Yellow Bass	......	.2	.5	1.0	*	*	.2
Chain Pickerel	1.7	.6	.1	.3	1.3	.6	.9
Longnose Gar	2.7	......	......	....	2.4	......	1.1
Shortnose Gar	......	... ..	1.1	...	......	1.0	.3
Spotted Gar	.8	.5	.3	.7	.4	.7	.5
Yellow Catfish	.3	*	......	.6	......	*	.1
Total							
Game Fish	38.1	36.7	33.2	39.7	29.4	43.9	36.2
Available Game Fish	16.9	16.5	17.5	25.4	14.3	15.5	17.0
Commercial Fish	4.4	6.0	18.1	3.9	3.2	20.7	9.0
Available Commercial Fish	4.4	5.9	18.1	3.9	3.2	20.7	9.0

* Less than .05

TABLE No. 7

Number of Fish Per Acre Occurring in Rotenone Samples Taken from Lake Bistineau

Sample Number

Kind of Fish	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Non-Predaceous Fish	17,262	1,380	3,557	483	18,531	231	13,717	3,014	67,755	7,018	9,156	37,013	11,798	7,903	699	5,307	2,401	27,282
Bluegill Sunfish	14	57	267	139	419	46	3,983	2,138	2,065	759	4,691	6,892	6,526	4,508	6	1,799	16	87
Redear Sunfish	....	23	213	113	109	45	975	94	93	53	1,198	1,245	3,322	3,110	17	604	13	22
Longear Sunfish	....	....	....	....	....	....	....	....	....	....	21	1	....	....	....	12	....	....
Warmouth Sunfish	....	52	64	3	15	....	1,804	211	3,481	150	996	22,133	517	95	1	543	1	4
Stumpknocker Sunfish	....	....	1	....	....	....	1,311	327	25	30	77	111	67	37	....	177	....	....
Orangespotted Sunfish	....	....	....	....	....	....	50	7	....	1	....	71	2	12	....	....	....	....
Small Sunfish	....	....	....	....	....	....	1,691	6	271	11	1,053	3,280	446	1	....	43	....	....
Hybrid Sunfish	....	....	....	1	....	....	....	....	1	2	....	....	....	....	....	....	....	....
Pirate Perch	....	....	....	1	....	....	437	1	....	7	....	168	11	5	....	128	....	....
Gizzard Shad	212	19	55	35	277	5	23	20	359	147	9	90	13	93	16	34	10	19
Threadfin Shad	17,036	1,229	2,957	190	17,711	135	3,223	208	61,452	5,856	1,104	3,007	827	27	658	1,925	2,361	27,149
Drum	....	....	....	1	....	....	....	....	....	....	....	....	....	7	1	1	....	....
Smallmouth Buffalo	....	....	....	....	....	....	....	....	....	....	....	....	....	8	....	2	....	1
Lake Chubsucker	....	....	....	....	....	....	50	....	5	....	4	8	6	....	....	6	....	....
Yellow Bullhead	....	....	....	....	....	....	169	2	3	2	2	7	55	....	....	20	....	....
Eel	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	2	....	....
Madtom	....	....	....	....	....	....	....	....	....	....	....	....	6	....	....	11	....	....
Golden Shiner	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....
Predaceous Fish	2	22	....	4	14	13	177	128	132	91	89	119	109	49	3	91	....	1
Largemouth Bass	....	22	....	....	12	....	78	51	29	44	15	44	63	49	....	64	....	1
Kentucky Bass	....	....	....	1	....	....	....	....	....	....	....	1	....	....	....	1	....	....
White Crappie	....	....	....	....	....	2	1	....	....	....	....	....	....	....	....	....	....	....
Black Crappie	....	....	....	....	2	7	80	71	89	46	65	58	45	....	....	18	....	....
Yellow Bass	2	....	....	3	....	4	....	....	....	....	....	....	....	....	3	1	....	....
Chain Pickerel	....	....	....	....	....	....	10	2	10	1	6	14	1	....	....	6	....	....
Longnose Gar	....	....	....	....	....	....	....	....	1	....	3	....	....	....	....	....	....	....
Shortnose Gar	....	....	....	....	....	....	6	....	....	....	....	....	....	....	....	....	....	....
Spotted Gar	....	....	....	....	....	....	2	3	3	....	....	2	....	....	....	....	....	....
Yellow Catfish	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	1	....	....
Total	17,264	1,402	3,557	487	18,545	244	13,894	3,142	67,887	7,109	9,245	37,132	11,907	7,952	702	5,398	2,401	27,283
Game fish	16	154	545	260	557	104	9,983	2,907	6,064	1,097	8,122	33,850	10,989	7,812	27	3,268	30	114
Available Game Fish	2	41	150	159	75	39	99	198	236	97	75	90	121	131	8	101	12	51
Commercial Fish	....	....	....	1	....	....	227	6	12	2	9	17	61	15	1	30	....	1
Available Commercial Fish	....	....	....	1	....	....	227	6	12	2	9	17	61	15	1	29	....	1

TABLE No. 8
Percent of Total Number of Fish Occurring in Rotenone Samples Taken from Lake Bistineau

Kind of Fish	Sample Number																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Non-Predaceous Fish	100.0	98.4	100.0	99.2	99.9	94.7	98.7	95.9	99.8	98.7	99.0	99.7	99.1	99.4	99.6	98.3	100.0	100.0
Bluegill Sunfish	.1	4.1	7.5	28.5	2.3	18.9	28.7	68.1	3.0	10.7	50.7	18.6	54.8	56.7	.9	33.3	.7	.3
Redear Sunfish	......	1.6	6.0	23.2	.6	18.4	7.0	3.0	.1	.8	13.0	3.4	27.9	39.1	2.4	11.2	.5	.1
Longear Sunfish	......	......	......	......	......	......	......	......	......	......	.2	*	......	......	......	.2	......	......
Warmouth Sunfish	......	3.7	1.8	.6	.1	......	13.0	6.7	5.1	2.1	10.8	59.6	4.3	1.2	.1	10.1	*	*
Stumpknocker Sunfish	......	......	*	......	......	......	9.4	10.4	*	.4	.8	.3	.6	.5	......	3.3	......	......
Orangespotted Sunfish	......	......	......	......	......	......	.4	.2	......	*	......	.2	*	.2	......	......	......	......
Small Sunfish	......	......	......	......	......	......	12.2	.2	.4	.2	11.4	8.8	3.8	*	......	.8	......	......
Hybrid Sunfish	......	......	......	.2	......	......	......	......	*	*	......	......	......	......	......	......	......	......
Pirate Perch	......	......	......	.2	......	......	3.2	*	......	.1	......	.5	.1	.1	......	2.4	......	......
Gizzard Shad	1.2	1.4	1.6	7.2	1.5	2.1	.2	.6	.5	2.1	.1	.2	.1	1.2	2.3	.6	.4	.1
Threadfin Shad	98.7	87.7	83.1	39.0	95.5	55.3	23.2	6.6	90.5	82.4	11.9	8.1	7.0	.3	93.7	35.7	98.3	99.5
Drum	......	......	......	.2	......	......	......	......	......	......	......	......	......	.1	.1	*	......	......
Smallmouth Buffalo	......	......	......	......	......	......	......	......	......	......	......	......	......	.1	......	*	......	*
Lake Chubsucker	......	......	......	......	......	......	.4	......	*	......	*	*	.1	......	......	.1	......	......
Yellow Bullhead	......	......	......	......	......	......	1.2	.1	*	*	*	*	.5	......	......	.4	......	......
Eel	......	......	......	......	......	......	*	......	......	......	......	......	......	......	......	*	......	......
Madtom	......	......	......	......	......	......	......	......	......	......	......	......	.1	......	......	.2	......	......
Golden Shiner	......	......	......	......	......	......	......	......	......	......	*	......	......	......	......	......	......	......
Predaceous Fish	*	1.6	......	.8	.1	5.3	1.3	4.1	.2	1.3	1.0	.3	.9	.6	.4	1.7	......	*
Largemouth Bass	......	1.6	......	......	.1	......	.6	1.6	*	.6	.2	.1	.5	.6	......	1.2	......	*
Kentucky Bass	......	......	......	.2	......	......	......	......	......	......	......	*	......	......	......	*	......	......
White Crappie	......	......	......	......	......	.8	*	......	......	......	......	......	......	......	......	......	......	......
Black Crappie	......	......	......	......	*	2.9	.6	2.3	.1	.7	.7	.2	.4	......	......	.3	......	......
Yellow Bass	*	......	......	.6	......	1.6	......	......	......	......	......	......	......	......	.4	*	......	......
Chain Pickerel	......	......	......	......	......	......	.1	.1	*	*	.1	*	*	......	......	.1	......	......
Longnose Gar	......	......	......	......	......	......	......	......	*	......	*	......	......	......	......	......	......	......
Shortnose Gar	......	......	......	......	......	......	*	......	......	......	......	......	......	......	......	......	......	......
Spotted Gar	......	......	......	......	......	......	*	.1	*	......	......	*	......	......	......	......	......	......
Yellow Catfish	......	......	......	......	......	......	......	*	......	......	......	......	......	......	......	*	......	......
Total																		
Game fish	.1	11.0	15.3	53.4	3.0	42.6	71.9	92.5	8.9	15.5	87.9	91.2	92.3	98.3	3.9	60.5	1.3	.4
Available Game fish	*	2.9	4.2	32.7	.4	16.0	.7	6.3	.4	1.4	.8	.2	1.0	1.7	1.1	1.9	.5	.2
Commercial Fish	......	......	......	.2	......	......	1.6	.2	*	*	.1	.1	.5	.2	.1	.6	......	*
Available Commercial Fish	......	......	......	.2	......	......	1.6	.2	*	*	.1	.1	.5	.2	.1	.6	......	*

* Less than .05

TABLE No. 9

Pounds of Fish Per Acre Occurring in Rotenone Samples Taken from Lake Bistineau

Sample Number

Kind of Fish	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Non-Predaceous Fish	47.3	23.1	83.0	88.9	125.5	9.0	120.7	84.9	434.1	162.9	68.1	73.0	90.9	257.3	22.9	101.6	28.3	146.0
Bluegill Sunfish	.1	2.9	8.2	12.3	13.7	2.0	27.1	57.2	64.6	23.9	26.4	15.6	26.0	15.5	.2	15.7	.3	7.9
Redear Sunfish	....	6.0	21.9	33.2	7.5	4.2	4.7	3.4	2.1	2.4	12.4	11.3	37.9	31.2	2.3	12.5	2.8	1.0
Longear Sunfish	....	....	....	....	....	....	....	....	....	....	.1	*	....	....	....	.1	....	....
Warmouth Sunfish	....	.2	.3	.1	*	....	18.5	9.6	10.9	2.5	6.1	10.2	1.9	1.4	*	5.9	*	*
Stumpknocker Sunfish	....	....	.1	....	....	....	5.4	1.8	.6	.8	.9	1.2	.4	.5	....	1.0	....	....
Orangespotted Sunfish	....	....	....	....	....	....	.3	*	....	*	....	.3	*	.3	....	....	....	....
Small Sunfish	....	....	....	....	....	....	3.7	*	.6	*	3.1	5.3	1.2	*	....	.1	....	....
Hybrid Sunfish	....	....	....	.3	....	....	....	....	.2	.5	....	....	....	....	....	....	....	....
Pirate Perch	....	....	....	*	....	....	1.3	*	....	*	....	.5	.1	*	....	.7	....	....
Gizzard Shad	6.1	9.9	28.5	39.5	29.9	2.0	25.2	11.4	11.3	12.8	10.5	16.5	15.5	113.3	15.5	29.8	10.6	15.8
Threadfin Shad	41.1	4.1	24.0	1.0	74.4	.8	20.3	1.5	340.0	120.0	7.2	10.2	5.3	.1	2.9	12.1	14.6	114.3
Drum	....	....	....	2.5	....	....	....	....	....	....	....	....	....	25.6	2.0	3.4	....	....
Smallmouth Buffalo	....	....	....	....	....	....	....	....	....	....	....	....	....	69.4	....	17.5	....	7.0
Lake Chubsucker	....	....	....	....	....	....	11.1	....	3.1	....	1.0	1.8	.5	....	....	1.5	....	....
Yellow Bullhead	....	....	....	....	....	....	2.2	*	.7	*	.3	.1	2.1	....	....	.5	....	....
Eel	....	....	....	....	....	....	.9	....	....	....	....	....	....	....	....	.8	....	....
Madtom	....	....	....	....	....	....	....	....	....	....	....	....	*	....	....	*	....	....
Golden Shiner	....	....	....	....	....	....	....	....	....	....	.1	....	....	....	....	....	....	....
Predaceous Fish	1.1	4.7	....	2.5	1.3	1.9	25.1	46.4	46.7	21.7	29.9	11.0	7.6	15.2	1.5	11.0	....	*
Largemouth Bass	....	4.7	....	....	1.3	....	13.0	27.9	13.6	12.4	3.9	5.3	6.8	15.2	....	7.3	....	*
Kentucky Bass	....	....	....	.8	....	....	....	....	....	....	....	1.0	....	....	....	*	....	....
White Crappie	....	....	....	....	....	1.2	*	....	....	....	....	....	....	....	....	....	....	....
Black Crappie	....	....	....	....	*	.4	2.4	11.8	17.1	7.4	1.6	1.4	.3	....	....	.8	....	....
Yellow Bass	1.1	....	....	1.7	....	.3	....	....	....	....	....	....	....	....	1.5	*	....	....
Chain Pickerel	....	....	....	....	....	....	.7	1.1	9.7	1.9	2.3	.4	.5	....	....	2.8	....	....
Longnose Gar	....	....	....	....	....	....	....	....	2.3	....	22.1	....	....	....	....	....	....	....
Shortnose Gar	....	....	....	....	....	....	7.2	....	....	....	....	....	....	....	....	....	....	....
Spotted Gar	....	....	....	....	....	....	1.8	3.1	4.0	....	....	2.9	....	....	....	....	....	....
Yellow Catfish	....	....	....	....	....	....	....	2.5	....	....	....	....	....	....	....	.1	....	....
Total	48.4	27.8	83.0	91.4	126.8	10.9	145.8	131.3	480.8	184.6	98.0	84.0	98.5	272.5	24.4	112.6	28.3	146.0
Game Fish	1.2	13.8	30.5	48.4	22.5	8.1	75.8	112.8	119.4	51.8	56.8	52.0	75.0	64.1	4.0	46.2	3.1	8.9
Available Game Fish	1.1	11.5	21.5	45.0	10.9	6.1	23.1	54.9	56.1	25.7	14.1	17.9	19.7	28.9	3.6	21.4	2.9	7.6
Commercial Fish	....	....	....	2.5	....	....	22.3	5.6	10.1	*	23.4	4.8	2.6	95.0	2.0	23.0	....	7.0
Available Commercial Fish	....	....	....	2.5	....	....	22.3	5.6	10.1	*	23.4	4.8	2.6	95.0	2.0	22.9	....	7.0

* Less than .05

TABLE No. 10

Percent of Total Pounds of Fish Occurring in Rotenone Samples Taken from Lake Bistineau

Sample Number

Kind of Fish	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Non-Predaceous Fish	97.7	83.1	100.0	97.3	99.0	82.6	82.8	64.7	90.3	88.2	69.5	86.9	92.3	94.4	93.9	90.2	100.0	100.0
Bluegill Sunfish	.2	10.4	9.9	13.5	10.8	18.4	18.6	43.6	13.4	13.0	26.9	18.6	26.4	5.7	.8	13.9	1.1	5.4
Redear Sunfish		21.6	26.4	36.3	5.9	38.5	3.2	2.6	.4	1.3	12.7	13.5	38.5	11.5	9.4	11.1	9.9	.7
Longear Sunfish											.1	*				.1		
Warmouth Sunfish		.7	.4	.1	*		12.7	7.3	2.3	1.4	6.2	12.1	1.9	.5	*	5.2	*	*
Stumpknocker Sunfish			.1				3.7	1.4	.1	.4	.9	1.4	.4	.2		.9		
Orangespotted Sunfish							.2	*		*		.4	*	.1				
Small Sunfish							2.5	*	.1	*	3.2	6.3	1.2	*		.1		
Hybrid Sunfish				.3					*	.3								
Pirate Perch				*			.9	*		*		.6	.1	*		.6		
Gizzard Shad	12.6	35.6	34.3	43.2	23.6	18.4	17.3	8.7	2.4	6.9	10.7	19.6	15.7	41.6	63.5	26.5	37.5	10.8
Threadfin Shad	84.9	14.8	28.9	1.1	58.7	7.3	13.9	1.1	70.7	65.0	7.4	12.1	5.4	*	11.9	10.8	51.6	78.3
Drum				2.7										9.4	8.2	3.0		
Smallmouth Buffalo														25.5		15.5		4.8
Lake Chubsucker							7.6		.6		1.0	2.1	.5			1.3		
Yellow Bullhead							1.5	*	.2	*	.3	.1	2.1			.4		
Eel							.6									.7		
Madtom													*			*		
Golden Shiner											.1							
Predaceous Fish	2.3	16.9		2.7	1.1	17.4	17.2	35.3	9.7	11.8	30.5	13.1	7.7	5.6	6.2	9.8		*
Largemouth Bass		16.9			1.1		8.9	21.2	2.8	6.7	4.0	6.3	6.9	5.6		6.5		*
Kentucky Bass				.9								1.2				*		
White Crappie						11.0	*											
Black Crappie					*	3.7	1.7	9.0	3.6	4.0	1.6	1.7	.3					
Yellow Bass	2.3			1.9		2.8									6.2			
Chain Pickerel							.5	.8	2.0	1.0	2.4	.5	.5			2.5		
Longnose Gar									.5		22.6							
Shortnose Gar							4.9											
Spotted Gar							1.2	2.4	.8			3.5						
Yellow Catfish								1.9										
Total																		
Game Fish	2.5	49.6	36.8	53.0	17.7	74.3	52.0	85.9	24.8	28.1	58.0	61.9	76.1	23.5	16.4	41.0	11.0	6.1
Available Game Fish	2.3	41.4	25.9	49.2	8.6	56.0	15.8	41.8	11.7	13.9	14.4	21.3	20.0	10.6	14.8	19.0	10.3	5.2
Commercial Fish				2.7			15.3	4.3	2.1	*	23.9	5.7	2.6	34.9	8.2	20.4		4.8
Available Commercial Fish				2.7			15.3	4.3	2.1	*	23.9	5.7	2.6	34.9	8.2	20.3		4.8

* Less than .05

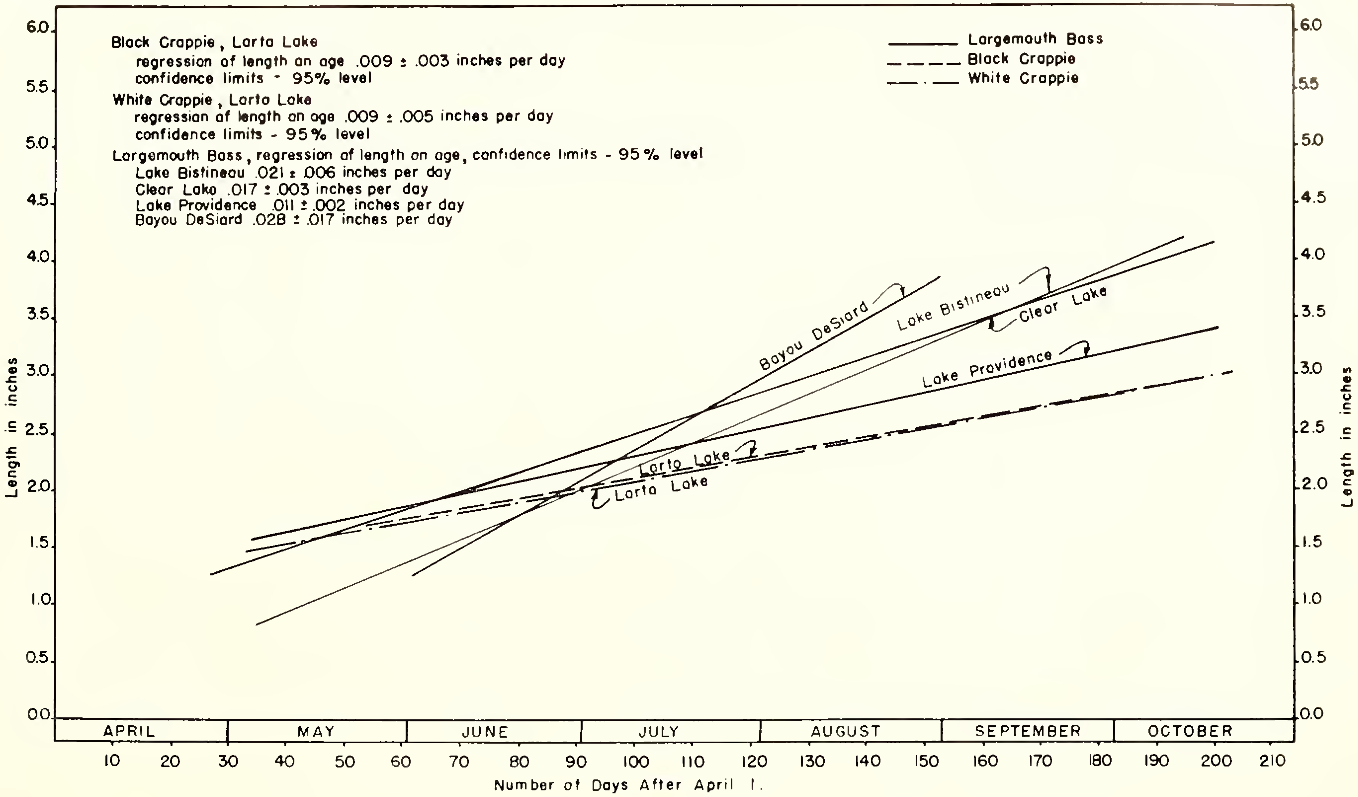


Fig. 7—Regression of length on age of young of the year—Black Crappie, White Crappie and Largemouth Bass.

Determination of Growth Rate of Young of the Year Largemouth Bass, Black Crappie and White Crappie

Young of the year largemouth bass, black crappie and white crappie were sampled with a 15 foot common sense minnow seine and a 6 foot otter trawl of ¼ inch square mesh. Samples were taken at approximately monthly intervals during the spring, summer and fall of 1955 from 5 bodies of water which are as follows: (1) Larto Lake, (2) Lake Bistineau (3) Clear Lake, (4) Lake Providence, and (5) Bayou DeSiard. All young of the year fishes were measured and the average length of each species was computed for each sampling period. The growth rates were determined by regression analysis.

Young of the year largemouth bass were not numerous enough in any of the trawl samples for the data to be used as a basis in estimating growth rates. Likewise, young of the year largemouth bass were not numerous enough in the minnow seine samples taken from Larto Lake for the data to be used as a basis in estimating growth rates. Young largemouth bass were numerous in the minnow seine samples taken from Lake Bistineau, Clear Lake, Lake Providence and Bayou DeSiard; and the data from these samples were analyzed in order to estimate their growth rates.

Examination of the empirical data showed that the regression of length on age was linear. The regression equations were calculated by the method of least squares. Average length of the fish at any given sampling period or day was used as the estimated length in calculating the regression equation. The estimated growth rates are based on 163 fish collected from Lake Bistineau, 613 fish collected from Clear Lake, 298 fish collected from Lake Providence and 66 fish collected from Bayou DeSiard.

The regression equations for these data are:

1. Lake Bistineau........................ $L = .121 + .021A$
2. Clear Lake.............................. $L = .769 + .017A$
3. Lake Providence....................... $L = 1.201 + .011A$
4. Bayou DeSiard......................... $L = -.461 + .0228A$

where L is the total length in inches and A is the age in days after April 1. The graphs of the regression equations are shown in Figure 7.

The growth rates of the young of the year largemouth bass are:

1. Lake Bistineau.............. .021 ± .006 inches per day
2. Clear Lake..................... .017 ± .003 inches per day
3. Lake Providence.......... .011 ± .002 inches per day
4. Bayou DeSiard .... .028 ± .017 inches per day

The significance of the growth rates is there is 1 chance in 20 that the true growth rate does not lie within the confidence limits. The growth rates of the young of the year largemouth bass are shown graphically in Figure 8.

The estimated growth rate of largemouth bass from Bayou DeSiard was greater than all other bodies of water sampled; however, the confidence limits were so large that little significance is given to this estimate. It is believed that insufficient data are on hand to say if and how the growth rate of young largemouth bass differed from that of other bodies of water. The large experimental error of the growth rate is probably due to the fact that the estimate was based on only 66 fish and that bass were present in the minnow seine samples only during four sampling periods. The estimated growth rate of young largemouth bass is based on average lengths of fish for 6 sampling periods for the other bodies of water.

Young largemouth bass from Lake Bistineau and Clear Lake had a greater estimated growth rate than young largemouth bass from Lake Providence. It is probable that the difference was significant; however, the reason for the difference is not known.

No further increases in length of young largemouth bass could be demonstrated after the month of October. Average lengths of young largemouth bass occurring in minnow seine samples taken from Clear Lake and Lake Providence during the month of January were almost identical to the average lengths of young largemouth bass occurring in minnow seine samples taken during the month of October. Young largemouth bass from Lake Bistineau and Clear Lake probably reached a total length of approximately 4 to 4½ inches during their first growing season while young largemouth bass from Lake Providence probably reached a total length of approximately 3.5 inches during their first growing season.

Young black and white crappie were not numerous enough in any of the minnow seine samples for the data to be used as a basis in estimating growth rates. Young black and white crappie were numerous enough only in the trawl samples taken from Larto Lake for the data to be used as a basis in estimating growth rates. Therefore, estimates of the growth rates were made only for Larto Lake.

Examination of the empirical data showed that the regression was linear. The data were analyzed as described previously for young largemouth bass. The estimated growth rates

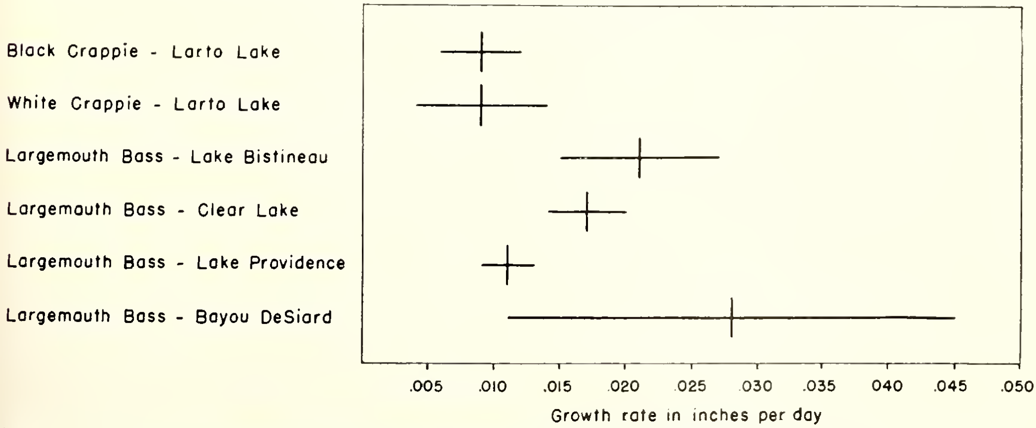


Fig. 8—Growth rate of young of the year black crappie, white crappie and largemouth bass. The vertical lines represent the calculated growth rate while the horizontal lines represent the confidence limits at the 95% level.

are based on 858 black crappie and 365 white crappie collected from Larto Lake.

The regression equations for these data are:

1. Black Crappie.......................L = 1.182 + .009A
2. White Crappie.......................L = 1.171 + .009A

The graphs of the regression equations are shown in Figure 7.

The calculated growth rates are:

1. Black Crappie.............. .009 ± .003 inches per day
2. White Crappie............ .009 ± .005 inches per day

The growth rates are shown graphically in Figure 8.

The estimated growth rates of young black and white crappie were almost identical. No further increase in length could be demonstrated after the month of October. Average lengths of young black and white crappie occurring in trawl samples taken during the month of January were identical to the average lengths of young black and white crappie taken during the month of October. Young black and white crappie probably reached a total length of approximately 3 inches during their first growing season in Larto Lake.

Knowing both the rate of growth of young fish per unit of time and the length obtained at the end of the growing season is helpful in evaluating age and growth data. For comparison purposes, such as comparisons of growth data between different growing seasons or between different bodies of water, estimates of the rate of growth per unit of time has advantages over estimates of length obtained at the end of the growing season. The rate of growth per unit of time will not be affected by differences in length of the growing season.

A sport fishery is dependent upon the establishment of successive year classes of sport fish or, in the case of some species of sport fish, the establishment of year classes every few years. The rate of growth of young fish when correlated with other factors such as size of brood is useful in evaluating the condition of the brood and in turn the fish population occurring in the body of water.

The main factor in determining the rate of growth of young fish is probably the availability of food. Competition between members of a brood for food and competition between the brood and other species of fish for food largely determines the availability of food for young fish. A growth rate of young fish that is slower than normal is, in most cases, due to (1) a very abundant year class of fish resulting in severe competition among members of the brood for food, (2) severe competition between the brood with other species of fish for food, or (3) a combination of the previous two causes. As a general rule, the smaller an animal, the more vulnerable it is to predators and hence any slowing up of the growth makes for greater predation losses. This would result in less fish of a brood becoming of size large enough to enter the sport fishery. The analysis of growth rates of young fish, especially of predaceous fish (piscivorous or carnivorous fish) such as largemouth bass, should be especially useful in determining the condition of fish populations occurring in Louisiana waters. For instance, during the fall of 1953, schools of small largemouth bass were observed along the shores of Clear Lake. These bass appeared to average approximately 2 inches or less in length and appeared to be extremely numerous. Small largemouth bass were also numerous in rotenone samples of the fish population taken from the lake during the month of October, 1953. These samples also showed that Clear Lake was overpopulated with gizzard shad. It was concluded that probably the spring spawn of largemouth bass in the lake during 1953 was very successful but because of severe competition for food with gizzard shad, sunfishes and other fishes, that the growth rate of young largemouth bass was rather slow. According to creel census and fish population data, there was no indication that the 1953 brood of young largemouth bass contributed much to the sport fishery on Clear Lake.

The determination of the growth rate of young largemouth bass would have given indications that the condition of the fish population occurring in Clear Lake was not satisfactory from a sport fishery management standpoint. The determination of growth rate of young fish, especially predaceous fishes such as largemouth bass, would be especially meaningful where the fish population balance or the control of forage fishes to prevent overpopulation is dependent upon predation by adult predaceous fishes.

Evaluation of Some of the Factors Affecting the Validity of Rotenone Sampling Data

The rotenone method of sampling fish populations is widely used throughout the southeast, and is generally accepted as the best available method for obtaining information about fish populations in most natural lakes and man made impoundments. Because of this we have tried to critically evaluate some of the factors which affect the validity of rotenone sampling data.

The factors affecting the validity of rotenone sampling data can be grouped into four general types: (1) the selectivity of the method, (2) variation in the amounts of fish recovered from different samples due to incompleteness of kill and/or pickup of fish, (3) the sample size, and (4) the method used in selecting the sample sites.

Other researchers have compared the results of fish population studies obtained from rotenone poisoning, gill nets, set lines, hoop nets, and sport fishing records and have concluded that rotenone poisoning yielded the most complete information about the fish population—the other methods were considered to be selective for certain species and size groups of fish.

Several workers have reported varying percentages of previously marked fish recovered from rotenone samples. Also, many workers make little attempt to include complete records of small fish with their sampling data. Serious bias can result from the failure to adequately account for small fish and the variation in the amounts of fish recovered from different samples due to incomplete kill and/or pick-up of fish.

There seems to be little standardization of the methods used to take rotenone samples. Some workers surround the area to be sampled with nets; other workers mark the area to be sampled with floats; while still others simply apply a curtain of poison around the sample area. A standardization in methods is necessary if samples, not only from the same body of water but from different water bodies, are to be compared. If this is not done, it is doubtful that any comparisons made will be valid because of differences in the completeness of recovery of fish from the sample areas.

In order to obtain samples which are comparable, we feel it is necessary to surround the sample area with some type of

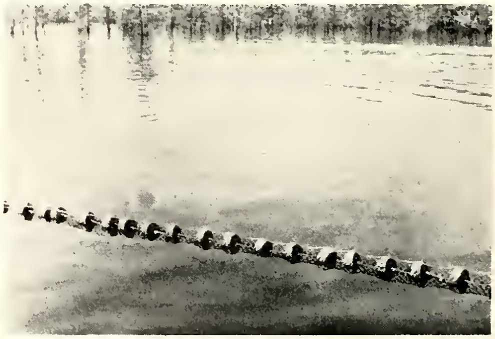


Fig. 9.—Block-off net used in taking rotenone samples of fish populations.

block-off net. Consequently, most of the samples we have taken from Louisiana waters were surrounded by a one inch square mesh block-off net with the corks spaced close together on the float line and the netting hung over the corks (Figure 9). This arrangement of the float line prevents waves from washing floating fish out of or into the sample area and, according to our observations, it is rather successful in accomplishing this except when the water is extremely rough.

The use of a block-off net has many advantages. It accurately delimits the sample area. It prevents fish, except very small individuals, from leaving or entering the treated area. It prevents fish which are selectively killed on the outside of the sample area, such as shad, from being included in the sample. From our observations, we have learned that the inclusion of shad which are selectively killed on the periphery of the sample area can seriously bias the data. The block-off net prevents the inclusion in the sample of predaceous fish (such as garfish and bass) which are attracted by the dying forage fish.

Any method of sampling will be more or less selective. However, rotenone sampling has the advantage, if sufficient attention is given to how the samples are taken, of not being extremely selective for any particular kind or size group of fish. It appears that the main inaccuracy associated with this method is that varying percentages of fish occurring in the sample areas are recovered. If sufficient attention is given to the problem of obtaining samples in which the ratio of nonrecovered fish to recovered fish is of approximately the same magnitude, then rotenone sampling should furnish a fairly accurate index by which the species composition and standing crop of fish in different bodies of water can be compared.

In rotenone sampling, very little attention has been given o the number of samples needed to make an estimate of the ish population within certain confidence limits.

In order to get some insight as to the sample size (i.e. umber of samples) needed, the variability of the total pounds f fish per acre occurring in rotenone samples taken from ake Bistineau and Caddo Lake were measured.

Both lakes are large impoundments, 17,200 and 10,100 acres espectively (10,100 acres includes only that portion of Caddo ake located in Louisiana—an additional 32,000 acres are loca-ed in Texas) and are located in northwest Louisiana. Even hough the lakes are large, they are rather shallow and it is ossible to take samples from almost all areas of either lake.

The data obtained from eighteen one-acre rotenone samples aken from Lake Bistineau during the late summer and early all of 1955 were analyzed. The samples were grouped for ummary purposes into seven sample groups (see previous section on rotenone sampling of fish populations occurring in ake Bistineau for description of sample groups).

The data obtained from ten-one acre rotenone samples taken rom Caddo Lake during the summer of 1954 were also nalyzed.

The means, standard deviations and coefficients of variation ere computed and are given in Table 11. All the coefficients f variation in Table 11 are large, indicating that the pounds f fish per acre occurring in the rotenone samples were quite ariable.

TABLE No. 11

Variability of total pounds of fish per acre occurring in tenone samples taken from Lake Bistineau and Caddo Lake.

	Sample Size	Mean	Standard Deviation	Coefficient of Variation
ke Bistineau				
Sample Group No. 1	4	223.7	175.09	78.27
Sample Group No. 2	8	78.6	41.69	53.04
Sample Group No. 3	6	112.0	95.33	85.12
Sample Group No. 4	5	88.3	52.11	59.01
Sample Group No. 5	8	130.0	153.18	117.83
Sample Group No. 6	5	142.7	76.10	53.33
Sample Group No. 7	18	122.0	110.24	90.36
ddo Lake	10	31.5	18.95	60.16

Sampling data are often stratified in order to reduce the experimental error. In order to determine if stratification of the samples by location on the lake will improve the precision of the estimate, an analysis of variance was run on the Lake Bistineau rotenone sampling data.

Sample groups 1, 2 and 3; and sample groups 4, 5 and 6 can be considered as two different stratifications of the samples by location on Lake Bistineau. The stratification of the samples into sample groups 1, 2 and 3 is designated as stratification A and the stratification of the samples into sample groups 4, 5 and 6 is designated as stratification B.

The analyses of variance for stratifications A and B are given in Tables 12 and 13. Both computed F values are not significant as the .05 level of probability. This indicates: (1) that the differences between the sample group means can be accounted for by chance variation and (2) stratification of the samples by location on the lake will not improve the precision of the estimate. Therefore, it is probable that there would be very little or no advantage in stratifying the samples taken from Lake Bistineau. Stratifying rotenone samples of fish populations taken from large bodies of water by type of habitat or in some similar manner is rather difficult because it is necessary to have an exact knowledge of the strata; that is, it is necessary to know exactly what constitutes the strata and the exact boundaries of the strata. Small errors in the weighing of strata may introduce enough bias to nullify any gain from stratification.

The sample size needed for the sample mean to be within a given percent of the true mean for a given probability can be estimated according to the following formula:

$$N = \frac{t^2 c^2}{p^2}$$

Where N = sample size
t = t value for a given probability
c = coefficient of variation
p = percent that sample mean is within true mean

TABLE No. 12

Analysis of variance of Lake Bistineau rotenone samples—stratification A.

	Sample Group No.		
	1	2	3
No. of Samples	4	8	6
Mean	223.7	78.6	112.0

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F
Among groups	2	5704.03	28520.52	2.86*
Within groups ..	15	149574.57	9971.64	
Total	17	206615.60		

* Not significant at .05 level of probability — a F value of 3.68 is required to be significant at the .05 level of probability.

TABLE No. 13

Analysis of variance of Lake Bistineau rotenone samples—stratification B.

	Sample Group No.		
	4	5	6
No. of Samples	5	8	5
Mean	88.3	130.0	142.7

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F
Among groups ...	2	8331.92	4165.96	.32*
Within groups ..	15	198283.68	13218.91	
Total	17	206615.60		

* Not significant at .05 level of probability — a F. value of 3.68 is required to be significant at the .05 level of probability.

Estimates were made of the sample size needed for the means of the samples taken from Lake Bistineau and Caddo Lake to be within a given percent of the true mean for a given probability. These estimates are shown graphically in Figures 10 and 11. It is readily seen that a large number of samples must be taken in order to estimate the total pounds of fish per acre to any degree of accuracy.

In instances where the sample comprises over five percent

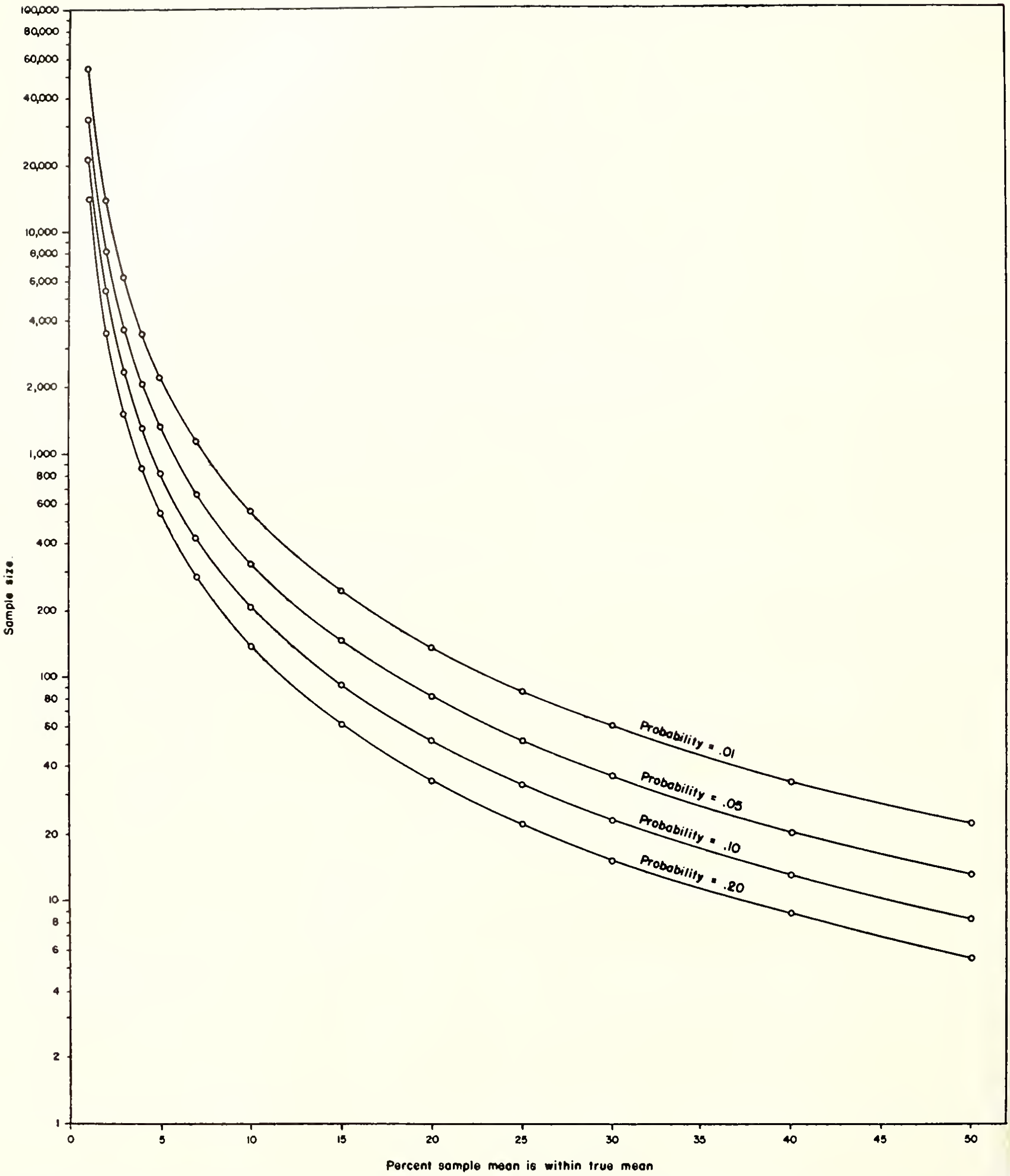


Fig. 10—Estimated size of sample needed for sample mean (total pounds of fish per acre occuring in rotenone samples from Lake Bistineau) to be within a given percent of the true mean for a given probability.

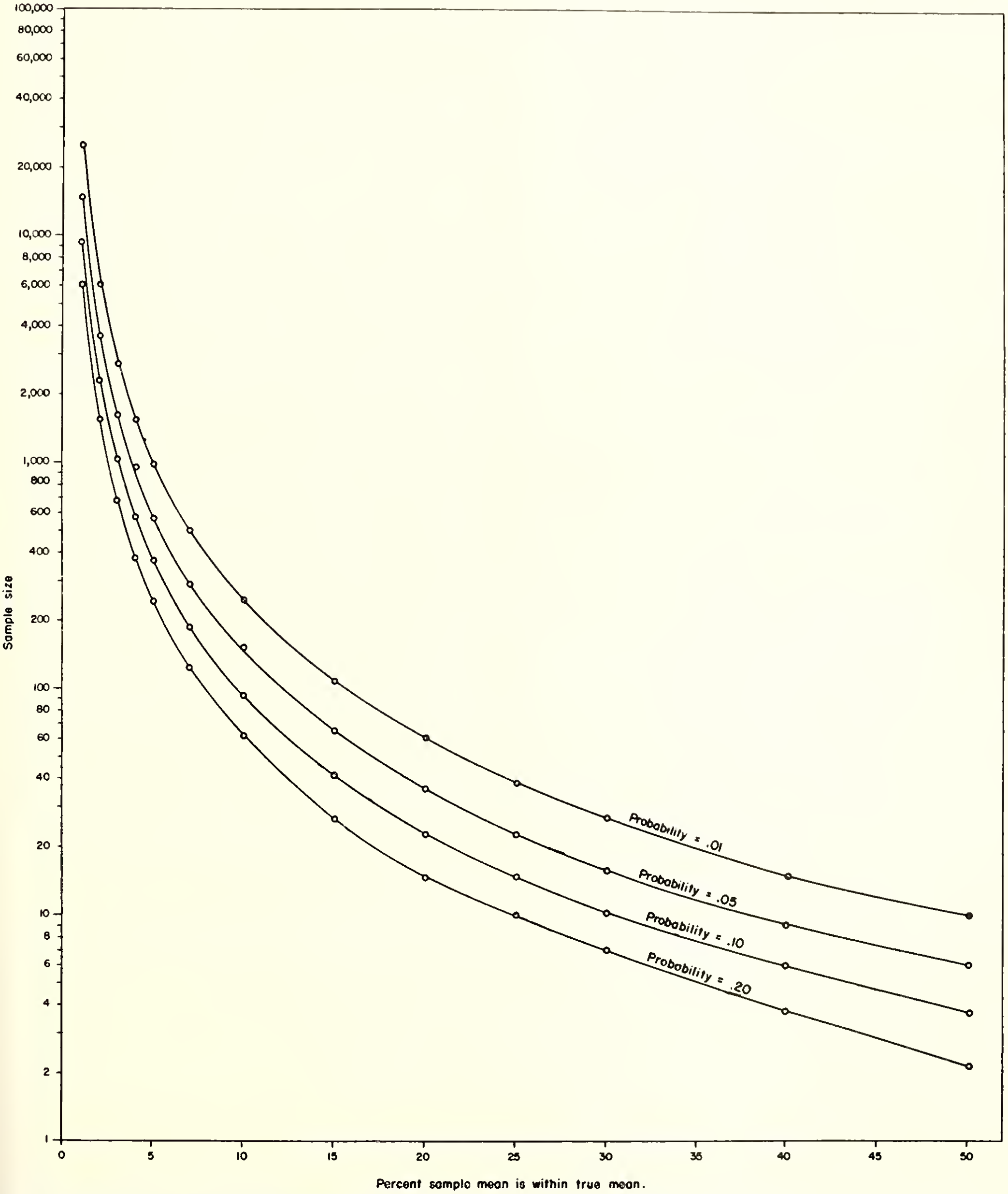


Fig. 11—Estimated size of sample needed for sample mean (total pounds of fish per acre occuring n rotenone samples from Caddo Lake) to be within a given percent of the true mean for a given probability.

or more of the population, a correction factor is usually used in computing the standard error. This is done because the possibilities of variation become less as the sample size approaches that of the population. This was not taken into consideration in estimating the sample sizes in this report and therefore in some instances a larger sample size is indicated than the area of the lake. However, it is extremely improbable that any investigator will be taking a sample of five percent or larger from a large lake. Five percent of the area of Lake Bistineau and Caddo Lake is 860 and 505 acres respectively.

The pounds of fish per acre occurring in rotenone samples taken from different bodies of water should have different coefficients of variation. This should be especially true for samples taken from different types of lakes. However, it is reasonable to assume that the amount of variation occurring in samples taken from lakes similar to Lake Bistineau and Caddo Lake will be in the same general range. Therefore, the data presented here should give some indication as to the sample size required in sampling such lakes.

The problem of how the sample sites should be selected in rotenone poisoning is rather perplexing and is worthy of considerable attention. In sampling large bodies of water containing diverse habitats, it is desirable to sample each of the environments present. This is seldom possible because the investigator is often limited by factors beyond his control. Usually the investigator can take only a limited number of samples and certain physical characteristics such as extreme depth and close proximity to human habitation can eliminate portions of a lake as potential sampling sites.

Any arbitrary selection of sample sites introduces bias to the data obtained from such samples, as sampling theory is based on randomization. The importance of how the sample sites are selected cannot be over-emphasized because the validity of the data is directly dependent upon it.

Use of Punch Card Methods in the Tabulation and Analysis of Fishery Refuge Data

Most fishery management agencies are faced with the problem of an ever increasing workload and a demand for more accurate and reliable information. Research programs are being expanded and their standards are rapidly rising, necessitating more detail and complex analyses of data, while at the same time, there is a shortage of trained fishery personnel. Therefore, it has become necessary to increase the efficiency of collecting and processing data.

The problem of assimilating the mass of material accumulated in normal biological surveys, determining the relationships and evaluating the relative weights of data, led to the investigation of methods other than manual for more rapidly and effectively making these recapitulations and computations. Our approach, and the one which we feel is most practical at the present time and at our present volume, has been to introduce the field data into punch cards for machine manipulation.

Punch card methods have been applied to the processing of creel census, fish sampling, age and growth, length-weight, condition and sex data. Other applications have been planned.

One of the greatest advantages of mechanical manipulation of data is the relative ease with which exploratory studies may be made. When a tally of ten-thousand cards can be made in less than half an hour, studies of questionable value can be investigated without a feeling of great waste when that particular avenue proves fruitless, and thus gives courage to investigate fields of uncertain potential.

Another advantage of punch cards is that the cards themselves can serve as a method of filing or storing data until needed. The data, once punched and verified, is readily available whenever needed, and it is possible to extract any information that might be needed with a minimum of effort.

Punch card tabulation is very applicable in any type of analyses where the same data is to be classified in many different ways. Take for instance the creel census card (Fig. 12). It might be necessary to determine the catch per unit of effort by area, date, day of week, time of day, non-resident fishermen, resident fishermen, sex, race, license holder, non-license holder, bait used, etc. The cards can be sorted by any of the above classifications and the catch per unit of effort determined with relative ease. For any volume of field data, the effort to determine these same statistics by manual tabulation would be much greater and much less accurate.

Standards of research are constantly rising and more precise and detailed analyses of data are being undertaken. Statistical methods of analyses are being applied to fishery research data much more frequently. This requires many more calculations; requires correlating different qualities; and necessitates cross classification of data and solving of complicated formulas. Some sort of machine tabulation of data is necessary if this trend is to continue. Punch card methods offer a reasonable solution. If a research organization has access to an electronic computer, the computation of standard

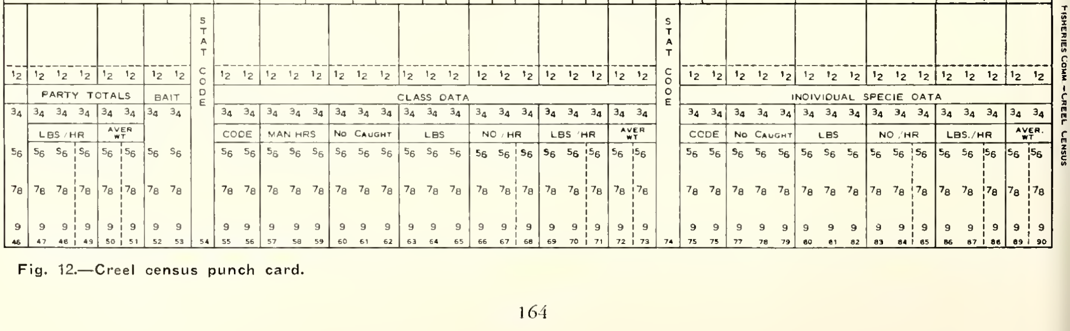


Fig. 12.—Creel census punch card.

deviations, standard errors, correlation coefficients, etc. for masses of data which man power consideration would not allow us to do by usual methods, can become a relatively simple matter.

The most helpful of all the auxiliary machines in punch card analyses are the electronic computers such as the Univac 120 Computer. The Univac Computer can be programmed to make any mathematical calculations in any sequence and procede or change its procedure in a predetermined way as a result of any calculation. These computations are carried on at almost unbelievable speeds. To illustrate this speed, consider the creel census cards (Fig. 12). In order to make certain statistical analyses, we are interested in the number and pounds of fish per hour for each fishing party. These analyses are to determine the validity of certain creel census procedures and to estimate sample sizes needed. The number of divisions necessary for the volume of data to be analyzed would require one man working steadily for a full year with a desk calculator. The Univac can make these same calculations in a single work day.

Our primary use of punch cards has been in the tabulation of creel census data. Figures 12 and 13 illustrate the field form and punch card used. The form and the card are largely self-explanatory, however, a few items need clarification.

In conducting creel censuses, we use the fishing party as our sampling unit. In addition to the general descriptive data such as sex, race, etc., we attempt to determine what class of fish the fishermen are fishing for—e.g., bass, crappie, sunfish, etc. The hours fished, number caught for each class of fish and the number and pounds of each species caught are also recorded.

In transferring the data from the field forms to the punch cards, it is usually necessary to use several cards for each fishing party. After punching the necessary information in columns 1 through 53 on the first card for a fishing party, the operator enters a 9 into the "Stat. Code" column 54. This card is designated as the *statistical* card (or party summary card) for the fishing party. Only this card will be used in accumulating any of the information contained in columns 1 through 53. After entering the "Stat. Code" 9 in column 54, the operator punches the class data into the card (columns 55 through 65). The first card for the class data has a 9 punched into "Stat. Code" column 74. The operator then punches the species data (columns 75 through 82) into the card. If more than one species of fish was caught for a class of fish, the operator enters the second fish into the next card according to the following procedure. In punching the second card, the operator deletes the "Stat. Code" 9 from column 54 and column 74 and then enters the data for the second species. The class and party data are repeated automatically in the second card. If a third or fourth species of fish was caught for a class of fish, the operator enters the data for the third species in the third card, the fourth species in the fourth card and so on. The class data and the party data are repeated automatically in each card. If a second type of fish was fished for, the operator enters the new class data into the card and places a "Stat. Code" 9 in column 74. The party data preceding the class data are repeated automatically. The data for the first species are then punched into the card. If a second species was caught, the "Stat. Code" 9 is deleted and the new species data are entered in the next card and so on. Only the first card for each party has a 9 in "Stat. Code" column 54, and only the first card for each class will have a "Stat. Code" 9 in column 74. Therefore, a sort on column 54 determines all party summary cards and enables us to accumulate party totals in additional sorts. Sorting on column 74 will isolate all class data cards, and will enable us to accumulate any class information. To accumulate species data, all cards are used. When the number of fish per hour, pounds of fish per hour, and the average weight are desired, these values are calculated by the Univac Computer and automatically punched into the card.

This arrangement of the cards with the "Stat. Code" columns make it possible to place an unlimited amount of information relative to a fishing party on the punch cards. It is also possible to make almost any type of correlation.

By using punch card methods, large amounts of data can be processed rapidly. However, these methods and their applications are not "cure alls"; they entail considerable planning, control and supervision.

Fish Populations Occurring in Some of the Streams on the Red Dirt Game Management Area, Natchitoches Parish, Louisiana

Fish population samples were taken from some of the small streams located on the Red Dirt Game Management Area. The samples were taken in order to determine the occurrence of creek chubs and the fish population composition in the streams.

On October 6, 1957, the fish populations in Coule Cobe Creek, Steep Hill Creek and Bayou L'Ivrogne were sampled with rotenone.

Coule Cobe Creek, in the vicinity of the sample area, was a very small, spring fed head water stream. The stream had a fairly steep gradient and a fairly good flow of water; it was extremely clear and had large numbers of small pools interspersed with riffle areas. The water shed was heavily wooded. Figure 14, which shows part of the creek typical of the area sampled, illustrates the size and physical make-up of the stream.

Steep Hill Creek, in the vicinity of the sample area, was a slightly larger stream than Coule Cobe Creek. The current was much slower and the pools were much larger. The creek contained riffle areas, however, they were much more widely spaced than those in Coule Cobe Creek.

Bayou L'Ivrogne contained only a series of isolated pools in the vicinity of the sample area.

The results of the samples are shown in Tables 14 through

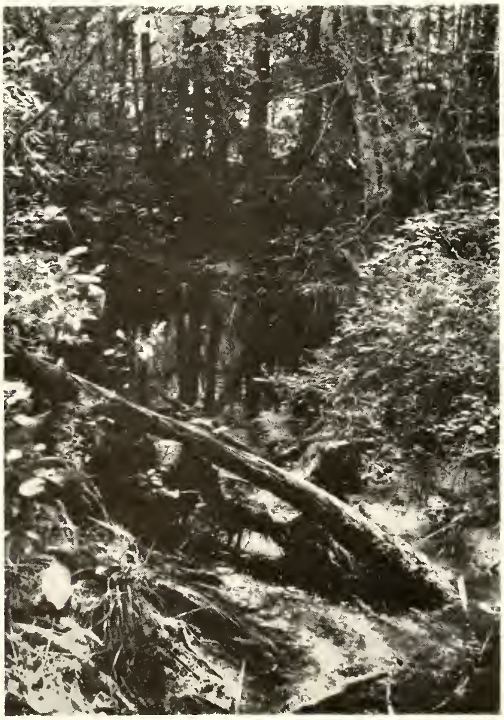
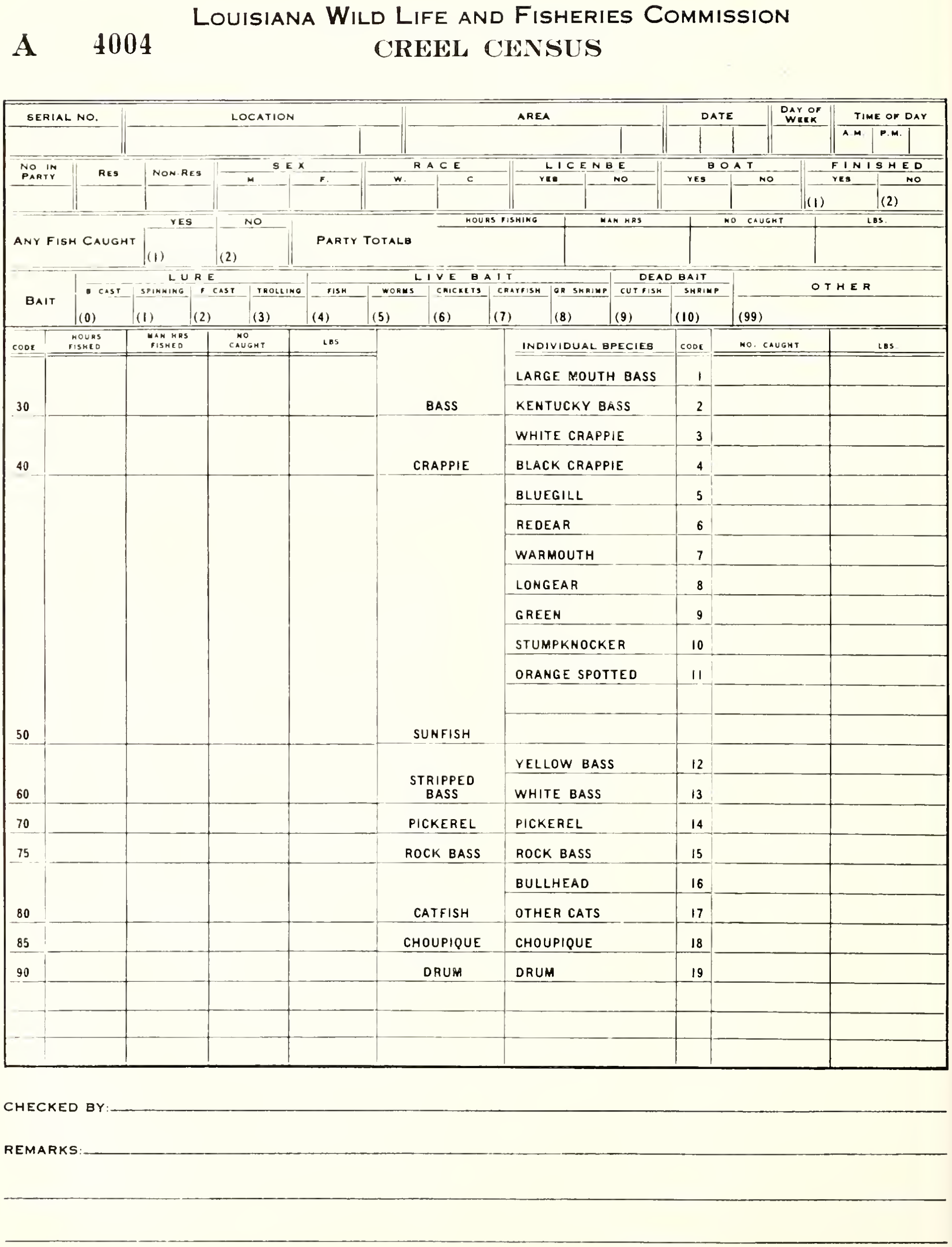


Fig. 14.—Coule Cobe Creek in the vicinity of the sample area.

Fig. 13 Sample of Creel census field form.



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LOUISIANA WILD LIFE AND FISHERIES COMMISSION
CREEL CENSUS

SERIAL NO.	LOCATION	AREA	DATE	DAY OF WEEK	TIME OF DAY A.M. P.M.

NO IN PARTY	RES	NON-RES	SEX		RACE		LICENSE		BOAT		FINISHED	
			M	F.	W.	C	YES	NO	YES	NO	YES	NO
											(1)	(2)

ANY FISH CAUGHT	YES	NO	PARTY TOTALS	HOURS FISHING	MAN HRS	NO CAUGHT	LBS.
	(1)	(2)					

BAIT	LURE				LIVE BAIT					DEAD BAIT		OTHER
	B CAST	SPINNING	F CAST	TROLLING	FISH	WORMS	CRICKETS	CRAYFISH	GR SHRIMP	CUT FISH	SHRIMP	
	(0)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(99)

CODE	HOURS FISHED	MAN HRS FISHED	NO CAUGHT	LBS		INDIVIDUAL SPECIES	CODE	NO. CAUGHT	LBS.
						LARGE MOUTH BASS	1		
30					BASS	KENTUCKY BASS	2		
						WHITE CRAPPIE	3		
40					CRAPPIE	BLACK CRAPPIE	4		
						BLUEGILL	5		
						REDEAR	6		
						WARMOUTH	7		
						LONGEAR	8		
						GREEN	9		
						STUMPKNOCKER	10		
						ORANGE SPOTTED	11		
50					SUNFISH				
						YELLOW BASS	12		
60					STRIPPED BASS	WHITE BASS	13		
70					PICKEREL	PICKEREL	14		
75					ROCK BASS	ROCK BASS	15		
						BULLHEAD	16		
80					CATFISH	OTHER CATS	17		
85					CHOUPIQUE	CHOUPIQUE	18		
90					DRUM	DRUM	19		

CHECKED BY: ______________________

REMARKS: ______________________

16. Creek chubs occurred only in the sample taken from Coule Cobe Creek. Freckled madtoms, creek chubs, pirate perch, creek chub suckers and mud pickerel were the most numerous fish in the sample taken from Coule Cobe Creek. Of interest was the complete absence of largemouth bass and Kentucky bass in the sample. A good many of the pools upstream from the sample area were visited and no bass were observed in any of them. Sunfishes were the most numerous fish in the sample taken from Steep Hill Creek. Longear sunfish, mud pickerel and banded pigmy sunfish were the most numerous fish in the sample taken from Bayou L'Ivrogne.

TABLE No. 14

Fish occurring in rotenone samples taken from Coule Cobe Creek.

Kind of Fish	Number	%	Average Length
Mud Pickerel	4	7.7	5.8
Creek Chub	8	15.4	5.1
Longear Sunfish	3	5.8	3.8
Green Sunfish	2	3.9	5.4
Pirate Perch	5	9.6	2.9
Yellow Bullhead	2	3.9	4.4
Freckled Madtom	21	40.4	3.4
Creek Chub Sucker	4	7.7	3.2
Blackstripe Topminnow	2	3.9	3.2
Common Shiner	1	1.9	4.0
Total Number	52	....	....

TABLE No. 15

Fish occurring in rotenone samples taken from Steep Hill Creek.

Kind of Fish	Number	%	Average Length
Largemouth Bass	4	8.0	5.6
Kentucky Bass	1	2.0	3.8
Mud Pickerel	3	6.0	8.9
Bluegill Sunfish	11	22.0	4.9
Longear Sunfish	6	12.0	2.9
Green Sunfish	3	6.0	3.5
Spotted Sunfish	1	2.0	3.1
Warmouth Sunfish	3	6.0	3.8
Flier Sunfish	3	6.0	3.5
Pirate Perch	4	8.0	2.9
Freckled Madtom	2	4.0	3.5
Creek Chub Sucker	4	8.0	4.7
Blacktail Redhorse	2	4.0	6.5
Blackstripe Topminnow	3	6.0	2.9
Total Number	50	....	....

TABLE No. 16

Fish occurring in rotenone samples taken from Bayou L'Ivrogne.

Kind of Fish	Number	%	Average Length
Largemouth Bass	1	2.3	4.1
Mud Pickerel	5	11.6	5.0
Longear Sunfish	15	34.9	2.9
Green Sunfish	3	7.0	1.2
Spotted Sunfish	1	2.3	1.4
Warmouth Sunfish	2	4.7	2.1
Banded Pigmy Sunfish	5	11.6	.8
Pirate Perch	4	9.3	1.8
Yellow Bullhead	1	2.3	1.2
Creek Chub Sucker	3	7.0	5.6
Blackstripe Topminnow	1	2.3	1.0
Unidentified Shiner	1	2.3	1.7
Unidentified Darter	1	2.3	1.3
Total Number	43	....	....

Catch of Wire Traps Fished in Lake Bistineau, Bayou Dorcheat and Clark's Bayou

Wire traps were fished in Lake Bistineau from April through August of 1956 in order to gather information regarding the status of the fish population in the lake. The mean catch per net day by time of year for the wire trap samples are given in Tables 17 and 18.

For sampling purposes, the lake was divided into mile long stations (Figure 15). The mean catch per net day by sampling stations are given in Table 19.

TABLE No. 17

Mean catch of fish per net day for wire traps fished in Lake Bistineau.

Kind of Fish	Time of Year Apr.	May	June	July	Aug.	Tot.
Largemouth Bass	.01	.13	.21	.03	...	.09
White Crappie	.01	.02	......	.01	......	.01
Black Crappie	.18	.15	.16	.77	4.36	.45
Bluegill Sunfish	2.36	5.77	2.36	1.40	1.79	2.91
Redear Sunfish	2.54	1.50	1.11	.54	.71	1.30
Warmouth Sunfish	.07	.14	.10	.02	.07	.08
Longear Sunfish	*	......	.01	......	......	*
Stumpknocker Sunfish	....	.17	.09	*	......	.06
Yellow Bass	.01	.01	.01	.....	......	.01
Chain Pickerel	.01	.08	.03	*	......	.03
Yellow Bullhead	......	.14	.07	.01	......	.05
Channel Catfish	......	.05	.01	.33	......	.12
Blue Catfish	...	......	......	*	......	*
Yellow Catfish	....	....	.01	......	......	*
Drum	..	.01	......	......	......	*
American Eel	.01	......	......	......	......	*
Spotted Gar	.03	.07	.08	*	......	.04
Shortnose Gar	.01	......	.01	.....	......	*
Alligator Gar	......	.02	......	....	......	.01
Gizzard Shad	*	......	*	......	......	*
Unknown Fishes	.....	.02	......	.01	......	.01
Lake Chub Sucker	.....	.03	.01	.01	......	.01
Unknown Sunfishes	.01	......	.01	......	......	*
Total	5.28	8.29	4.27	3.14	6.93	5.19
Number Samples	63	85	69	107	7	331

* Less than .005

TABLE No. 18

Mean catch of fish per net day for wire traps fished in Bayou Dorcheat and Clark's Bayou.

Kind of Fish	Bayou Dorcheat May	July	Total	Clark's Bayou May
Largemouth Bass	....	....	....	.13
White Crappie	.07	.....	.05	......
Black Crappie	.17	.31	.20	.38
Bluegill Sunfish	1.41	.19	1.15	1.25
Redear Sunfish	.38	......	.30	.25
Warmouth Sunfish	.24	....	.19	.50
Longear Sunfish	.03	......	.03	......
Stumpknocker Sunfish	.21	......	.16	......
Yellow Bass	.07	......	.05	.50
Chain Pickerel	.03	......	.03	......
Yellow Bullhead	.03	......	.03	.13
Black Bullhead	......	.....	......	.25
Channel Catfish	.03	.31	.09	......
Yellow Catfish	.03	......	.03	......
Spotted Gar	......	....	......	.13
Shortnose Gar	......	.....	.....	.13
Longnose Gar	.03	. .	.03	......
Lake Chub Sucker	......	....	......	.13
Total	2.76	.81	2.34	3.75
Number Samples	29	8	37	8

TABLE No. 19

Mean catch of fish per net day by location for wire traps fished in Lake Bistineau.

Kind of Fish	Sample Stations 1-4	5-8	9-12	13-16	17-19
Largemouth Bass	.08	.08	.11	.06	.10
White Crappie	.02	.01	.01	......	......
Black Crappie	.77	.76	.13	.07	.05
Bluegill Sunfish	4.07	3.58	1.80	.90	4.17
Redear Sunfish	2.22	1.21	.96	.52	.24
Warmouth Sunfish	.05	.04	.15	.04	.02
Longear Sunfish	......	.01	......	......	......
Stumpknocker Sunfish	.13	.04	.03	......	.10
Yellow Bass	......	.02	*	......	......
Chain Pickerel	.03	.01	.04	......	.05
Yellow Bullhead	.02	*	.14	.01	.07
Channel Catfish	.09	.42	.02	......	......
Blue Catfish	*	......	......	.....	......
Yellow Catfish	......	*	......	*	......
Drum	......	......	.01	......	......
American Eel	*	......	......	......	......
Spotted Gar	.05	.04	.04	......	.06
Shortnose Gar	......	......	*	......	.02
Alligator Gar	......	.....	.02	......	......
Gizzard Shad	......	*	*	......	......
Unknown Fishes	......	.01	.01	......	......
Lake Chub Sucker	......	*	.04	.02	......
Unknown Sunfishes	*	......	.01	......	......
Total	7.53	6.27	3.49	1.67	4.88
Number Samples	102	69	100	39	21

* Less than .005

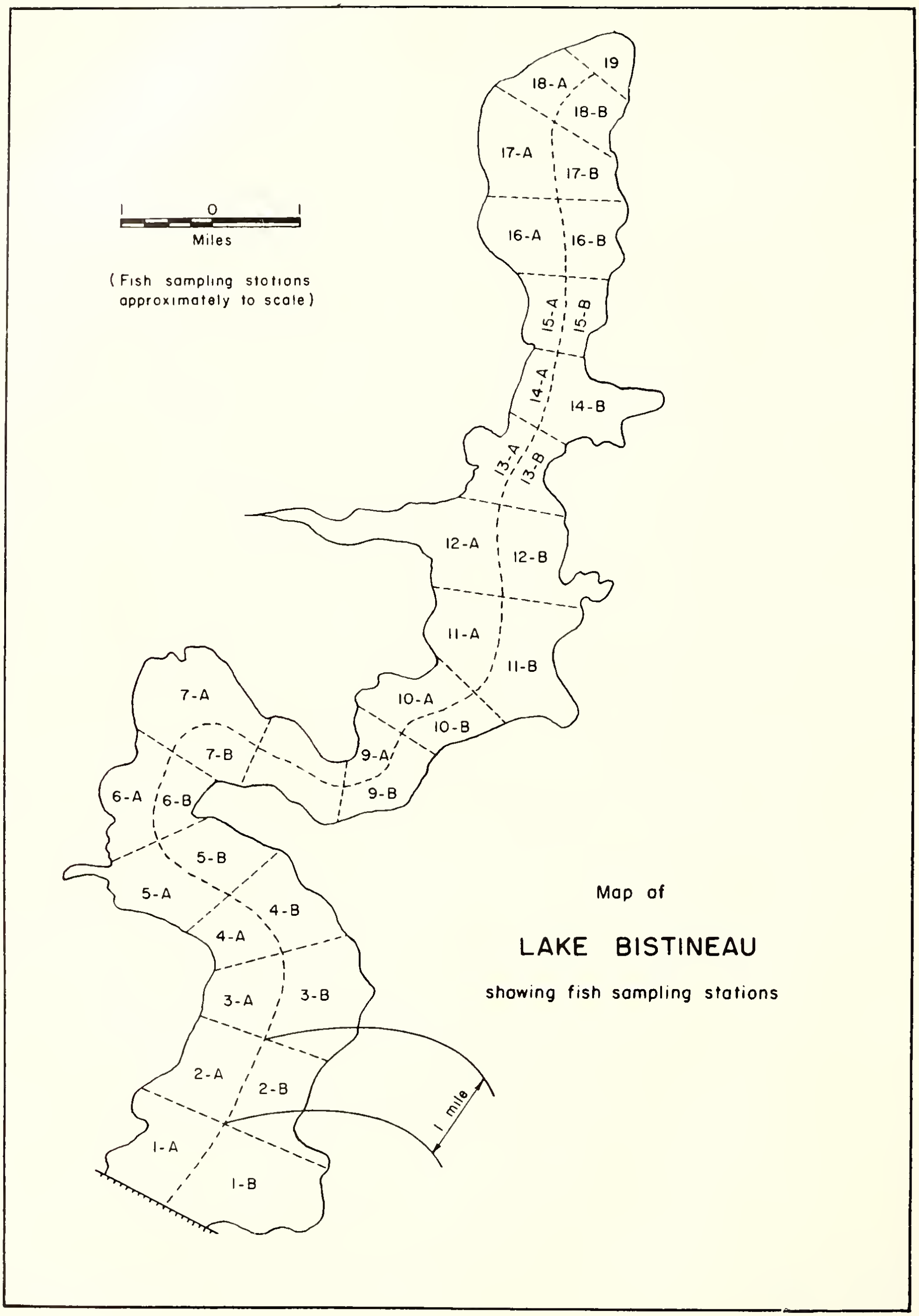
1
0
1
Miles
(Fish sampling stations
approximately to scale)
19
18-A
18-B
17-A
17-B
16-A
16-B
15-A
15-B
14-A
14-B
13-A
13-B
12-A
12-B
11-A
11-B
10-A
10-B
9-A
9-B
7-A
7-B
6-A
6-B
5-B
5-A
4-B
4-A
3-A
3-B
2-A
2-B
1-A
1-B
1 mile
Map of
LAKE BISTINEAU
showing fish sampling stations

Fig. 15

The approximate density of cover (logs, trees, stumps, aquatic plants, etc.) where each trap was set was noted. The mean catch per net day by density of cover are given in Table 20.

Each wire trap set was classified as to whether it was or was not an original set. An original set was when the trap or another trap had not been set in that location just previous to that set. If a trap was raised and emptied and then immediately returned to the water, the second set would not be considered as an original set. The mean catch per net day for the different types of sets are given in Table 21.

The depth of the water where each trap was set was noted and the mean catch per net day by depth of water are given in Table 22.

TABLE No. 20

Mean catch of fish per net day by density of cover for wire traps fished in Lake Bistineau

Kind of Fish	Density of Cover Open Water	Fairly Open Water	Medium	Dense Cover	Very Dense Cover
Largemouth Bass	.10	.03	2.00	.11	.34
White Crappie	.01	*		.02	
Black Crappie	1.13	.19		.41	.07
Bluegill Sunfish	1.91	2.61	13.75	3.42	8.05
Redear Sunfish	1.04	1.19	2.75	1.21	4.66
Warmouth Sunfish	.03	.09	.25	.07	.13
Longear Sunfish	*	*			
Stumpknocker Sunfish	.02	.05	2.50	.05	.19
Yellow Bass	*	*			.07
Chain Pickerel	.01	.02		.04	.21
Yellow Bullhead	*	.06		.09	.06
Channel Catfish	.43			.02	
Blue Catfish	.01				
Yellow Catfish	.01				
Drum				.01	
American Eel		*			
Spotted Gar	.01	.03		.09	.09
Shortnose Gar		*		.01	
Alligator Gar		.01			
Gizzard Shad		*		*	
Unknown Fishes	.01	.01			
Lake Chub Sucker		.02		.02	
Unknown Sunfishes		.01			
Total	4.73	4.36	21.25	5.56	13.89
Number Samples	75	159	2	77	14

TABLE No. 22

Mean catch of fish per net day, by depth, for wire traps fished in Lake Bistineau.

Kind of Fish	Depth of Set in Feet 0-2.9	3.0-5.9	6.0-8.9	9.0-11.9	12.0-14.9	15.0-16.9
Largemouth Bass	.55	.28	.01	*		
White Crappie		.01	.02		.01	
Black Crappie	.03	.08	.52	.45	.99	.85
Bluegill Sunfish	3.66	3.20	3.30	2.26	3.28	.10
Redear Sunfish	.64	1.56	1.68	1.24	.61	.35
Warmouth Sunfish	.18	.17	.08	.01	.04	
Longear Sunfish		.01		*	*	
Stumpknocker Sunfish	.80	.09	.06			
Yellow Bass			*	.01	.01	
Chain Pickerel		.10	.02	*		
Yellow Bullhead	.65	.07	.05	*		
Channel Catfish			.10	.02	.50	2.55
Blue Catfish						.25
Yellow Catfish			*		.01	
Drum	.05					
American Eel					.01	
Spotted Gar	.12	.09	.04	.01	.01	
Shortnose Gar		.01				
Alligator Gar		.03				
Gizzard Shad		*	*			
Unknown Fishes		.02		*	.01	
Lake Chub Sucker	.05	.04	.02			
Unknown Sunfishes		.01		*		
Total	6.74	5.77	5.92	4.03	5.46	4.15
Number Samples	11	78	79	110	50	2

* Less than .005

During the month of July, some of the wire traps fished in Lake Bistineau were baited with cotton seed meal cake. The purpose of this was to determine if baiting the traps would increase their catches. The mean catch per net day for both baited and unbaited sets are given in Table 23.

The clearness of the water was noted when each trap was raised. The mean catch per net day by clearness of the water are given in Table 24.

TABLE No. 21. Comparison of the mean catch per net day for different types of sets of wire traps fished in Lake Bistineau.

	TIME OF YEAR April		May		June		July		Total	
	Original Set		Original Set		Original Set		Original Set		Original Set	
Kind of Fish	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Largemouth Bass	.01		.06	.21	.23	.05	.02	.08	.08	.15
White Crappie	.01		.02	.02			.01		.01	.01
Black Crappie	.20	.03	.11	.20	.17	05	.81	.02	.51	.01
Bluegill Sunfish	2.60	1.02	7.25	3.57	2.50	.80	1.40	1.40	3.00	2.62
Redear Sunfish	2.89	1.22	1.99	.75	1.13	.90	.52	.82	1.40	.86
Warmouth Sunfish	.08	.06	.14	.14	.10	.05	.02	.06	.07	.11
Longear Sunfish	*				.01				*	
Stumpknocker Sunfish			.15	.21	.09	.05	*		.05	.16
Yellow Bass	.01		.02		.01				.01	
Chain Pickerel	.01	.06	.05	.13	.02	.05	*		.02	.09
Yellow Bullhead			.13	.08	.08		.01	.06	.05	.05
Channel Catfish			.08		.01		.35		.15	
Blue Catfish							*		*	
Yellow Catfish					*	.05			*	
Drum										
American Eel	.01									
Spotted Gar	.01	.18	.10	.02	.09		*	.06	.04	.05
Shortnose aGr	.01				.01				*	
Alligator Gar			.04						*	
Gizzard Shad	*				*				*	
Unknown Fishes				.04			.01		*	.01
Lake Chub Sucker			.03	.02	.01	.05	.01	.06	.01	.02
Unknown Sunfishes	.01				.01				*	
Total	5.83	2.53	10.20	5.40	4.40	2.07	3.17	2.62	5.37	4.27
Number Samples	53	9	51	33	63	6	102	5	276	53

* Less than .005

TABLE No. 23. Comparison of the mean catch per net day, percentage composition of the catch, and mean length (total length in inches) of fish caught for baited and unbaited wire traps fished in Lake Bistineau during the month of July. The figure in parenthesis represents the number of specimens.

Kind of Fish	Mean Catch Per Net Day		Percentage Composition		Mean Length	
	Baited	Unbaited	Baited	Unbaited	Baited	Unbaited
Largemouth Bass	.03	.02	1.1	6.	9.3(5)	9.7(4)
White Crappie	......	.02	......	.5	......	6.6(2)
Black Crappie	.48	1.02	18.3	28.5	6.2(51)	6.2(128)
Bluegill Sunfish	1.20	1.57	44.9	44.1	5.5(117)	5.7(182)
Redear Sunfish	.41	.64	15.7	18.0	7.1(63)	6.9(99)
Warmouth Sunfish	.02	.01	.9	.4	7.3(4)	6.6(2)
Longear Sunfish	......	......	......	......	......	......
Stumpknocker Sunfish	*	......	.2	......	5.3(1)	......
Yellow Bass	......	......	......	......	......	......
Chain Pickerel	......	.01	......	.1	......	19.9(1)
Yellow Bullhead	.02	......	.9	......	9.7(3)	......
Channel Catfish	.45	.23	17.2	6.6	10.6(58)	11.3(29)
Blue Catfish	.01	......	.4	......	9.8(2)	......
Yellow Catfish	......	......	......	......	......	......
Drum	......	......	......	......	......	......
American Eel	......	......	......	......	......	......
Spotted Gar	.01	*	.2	.1	19.2(1)	16.0(1)
Shortnose Gar	......	......	......	......	......	......
Alligator Gar	......	......	......	......	......	......
Gizzard Shad	......	......	......	......	......	......
Unknown Fishes	......	.01	......	.4	......	6.3(2)
Lake Chub Sucker	.01	.02	.2	.6	9.5(1)	9.1(4)
Unknown Sunfishes	......	......	......	......	......	......
Total	2.65	3.56	128.7	206.5	......	......
Number Samples	49	58	......	......	......	......

* Less than .005

TABLE No. 24

Mean catch of fish per net day, by clearness of water, for wire traps fished in Lake Bistineau.

Kind of Fish	Clearness of the Water				
	Very Clear	Clear	Murky	Very Murky	Muddy
Largemouth Bass	.09	.02	......	......	.94
White Crappie	.01	.01	.03	......	......
Black Crappie	.59	.27	.12	.05	.25
Bluegill Sunfish	3.36	3.38	.91	.50	.94
Redear Sunfish	1.01	3.00	.56	.18	2.00
Warmouth Sunfish	.05	.21	.04	.32	.25
Longear Sunfish	*	......	......	......	....
Stumpknocker Sunfish	.09	......	....	......	.13
Yellow Bass	.01	.01	......	......	......
Chain Pickerel	.03	.01	.07	.06	.06
Yellow Bullhead	.06	*	.08	.10	......
Channel Catfish	.17	.06	....	......	......
Blue Catfish	*	......	......	......	......
Yellow Catfish	*	......	......	......	......
Drum	*	......	......	......	......
American Eel	..	.02	....	......	......
Spotted Gar	.04	.05	......	.04	.13
Shortnose Gar	*	......	......	......	......
Alligator Gar	.....	.04	.04	......	......
Gizzard Shad	*	......	......	......	......
Unknown Fishes	*	....	.06	......	....
Lake Chub Sucker	.01	......	.07	......	.06
Unknown Sunfishes	......	.02	......	......	.06
Total	5.55	7.09	1.98	1.33	4.81
Number Samples	222	27	25	11	8

* Less than .005

Fish Populations Occurring in Louisiana Backwater Lakes, Mississippi River Oxbow Lakes and Louisiana Impoundments

Rotenone samples of the fish populations were taken in representative lakes and the data are summarized here. Probably it will be helpful to describe briefly what types of lakes we have included under the various headings.

In compiling a list of backwater lakes, there were border line cases where it was hard to decide if the lake should or should not be included in the listing. All the backwater lakes are located in the flood plains of major river systems. During periods of high water large expanses of land, which are normally dry, are flooded. Most of the high water stages occur during late winter, spring, and early summer; however, the intensity and length of flooding varies from year to year and from lake to lake.

All the Mississippi River oxbows were formed by the Mississippi River and are located in the old flood plain of the river. Due to the construction of levees, the oxbows have been completely separated from the Mississippi River and no longer receive any backwater or flood water from the river.

In compiling the list of impoundments, there were borderline cases where it was hard to decide whether the lake should or should not be included in the listing. All lakes included had some type of man made water control structure. This structure was, in some cases, the dam that created the lake, or in other cases, a dam that simply raised the water level over a naturally swampy area. Most of the lakes were rather large in size—at least several hundred acres. All of the lakes had a natural or native fish population. They did not contain a fish population consisting of only a few species, such as a population consisting solely of largemouth bass and bluegill sunfish. All the lakes were relatively shallow and many of them contained dense stands of aquatic plants. All of the lakes had their watersheds located in rather infertile land.

The data obtained from rotenone samples taken from seven backwater lakes were analyzed. Since most of the backwater lakes were rather shallow, it was possible to sample, in most cases, all areas of the lake. All samples were taken during periods of low water. The bodies of water sampled, the dates the samples were taken and the number of samples are as follows:

Body of Water	Date Sampled	Number of Samples
Colyell Bay	7/1954	2
Dubloon Bayou	7/1954	2
Bayou Courtableau Pits	8/1954	1
Spring Bayou Backwater Area	9/1954	4
Old River (Pointe Coupee Parish)	8/1955	3
Pearl River Backwater	5-6/1954	3
Bayou Courtableau	8/1954	2

The data obtained from rotenone samples taken from six

Mississippi River oxbow lakes were analyzed. Most of the Mississippi River oxbow lakes are relatively deep and therefore almost all the samples were taken along their shorelines. The bodies of water sampled, the dates the samples were taken and the number of samples taken are as follows:

Body of Water	Date Sampled	Number of Samples
Lake Bruin	5/1955	2
Lake St. Joseph	8/1954	3
False River	5/1955	2
Lake Concordia	5/1955	3
Lake St. John	5/1955	3
Lake Providence	8/1954	3

The data obtained from rotenone samples taken from eight impoundments were analyzed. Since all the impoundments were rather shallow, it was possible to sample almost all areas of the lake. The bodes of water sampled, the dates the samples were taken and the number of samples taken are as follows:

Body of Water	Date Sampled	Number of Samples
Lake Bistineau	8-9/1955	18
Corney Lake	6/1955	3
Caddo Lake	7-9/1954	10
Chicot Lake	9/1954	2
Black Lake	7/1954	3
Black Bayou Lake	7/1954	5
Black Bayou Lake	7-8/1956	5
Anacoco Lake	8/1955	3

Black Bayou Lake was increased in size from 1,950 acres to 3,960 acres during the winter of 1954-55. Because of this, the data collected from Black Bayou Lake during 1954 and 1956 were treated as if collected from two different lakes.

The sample areas were surrounded by a block-off net. Three pints of five percent emulsifiable rotenone per acre foot of water was applied by pumping the rotenone through a perforated hose. Fish were picked up over a two day period and every possible effort was made to pick up all the fish, especially small and fingerling fish.

For the most part, the sample areas were one-acre in size. If the sample area was not one acre in size, the data were converted to pounds of fish per acre and each sample obtained from a body of water was given equal weight.

The data from each body of water sampled were summed and the mean values were determined. The results from each body of water were considered as a separate index to the fish populations occurring in the various types of lakes. The mean value for each index by types of water was determined.

The fish occurring in the samples were separated into two main groups; non-predaceous and predaceous. This grouping is similar to Swingle's (1950) forage and carnivorous or piscivorous grouping. Predaceous fish are those species of fish that are normally throught of as feeding mainly on other and smaller fish. The term piscivorous fish was not used because we are of the opinion that crayfish and other large crustaceans make up a large percentage of the diet of bass and other large predators in some fish populations in Louisiana. According to observations made by the project leader, largemouth bass utilize crayfish extensively for forage in some Louisiana backwater habitats. Lambou (1952) also showed that blue crabs make up a large percentage of the diet of largemouth bass and other large predators in a Louisiana brackish water habitat. Actually almost all fish are predaceous to a degree, inasmuch as they feed on other organisms. Probably it would be more appropriate to use the term secondary predaceous fish or large predaceous fish. The non-predaceous fish are those species of fish that are normally thought of as not feeding mainly on other and smaller fish. In some cases, the placing of a species of fish into one group or another is arbitrary since the food habits of many fishes are not well known. It is also possible that the food habits of some species differ significantly in different types of habitat.

All species of fish that sport fishermen normally fish for were grouped under the heading of game fish. Available game fish are those fish that were considered to be of a size large enough to be creeled by sport fishermen. It is admitted that any minimum size assigned to a species of fish can only be arbitrary. What one fisherman would consider as an available size might not necessarily be so considered by another fisherman. The species of fish considered as game fish and their minimum available sizes are as follows:

Kind of Fish	Minimum Available Size (Total Lengths)
All Sunfishes	5 inches
Largemouth Bass	10 inches
Kentucky Bass	10 inches
White Crappie	7 inches
Black Crappie	7 inches
Yellow Bass	7 inches
White Bass	7 inches
Chain Pickerel	10 inches

All species of fish that are regularly or occasionally sold commercially were grouped under the heading of commercial fish. Some of the commercial fish are of a low commercial value while others support large and extensive commercial fisheries. Available commercial fish were those of a size that could legally be sold. If a species had no minimum size limit, all sizes were considered as being available.

In analyzing the data, standard statistical methods were used. In all statistical calculations, the "Normal Theory" was applied. Whether or not the distribution of all the indices were normal was not determined. However, it is believed that the distribution of the indices statistically analyzed were normal or approached normal to a point where normal theory could be safely applied. For some species of fish, the distribution of the indices were obviously not normal, but was similar to a binomial distribution. In some of these cases, the indices were grouped with other indices—for example, "other fishes" under both non-predaceous fish and predaceous fish. After grouping, these indices appeared to follow essentially a normal distribution. In other cases when the distribution was obviously not normal the indices were omitted from the statistical analysis.

The indices used from each body of water were treated in all statistical calculations as if they were without error. Obviously, as shown previously, this is not the case. Just how, or if, this would bias the calculations is not known. However, it is probable that the sampling error for each individual index is normally distributed and therefore these errors should be compensating and not cumulative. It is also possible that the individual indices from the various bodies of water sampled would vary less from the means if they were based on more intensive sampling. If this were the case, the confidence limits would be less than those presented in this report.

In all statistical calculations the finite correction factor was not used. The population was considered as being infinite; however, only a limited number of the various types of lakes actually exist in Louisiana. Therefore, the population sampled was partly imaginary inasmuch as it was considered as consisting of all possible lakes of the type described that could exist in Louisiana—whether or not they actually exist at the present time, or may or may not exist in the future. This is similar to the imaginary populations that are sampled in field plot experiments conducted by agricultural researchers.

Figures 16 through 21 summarize the standing crops of fish, relative species composition of standing crops, standing crops of available game fish, relative species composition of standing crops of available game fish, ratios of available game fish to the total standing crops (by kinds of fish) and some predator-prey relationships in the backwater lakes; Figures 22 through 27 summarize the same data for the Mississippi River oxbow lakes; and Figures 28 through 33 sum-

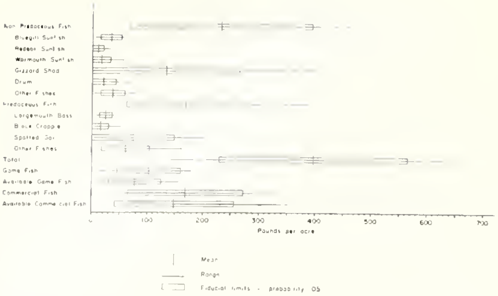

Fig. 16—Standing crops of fish in Louisiana backwater lakes.

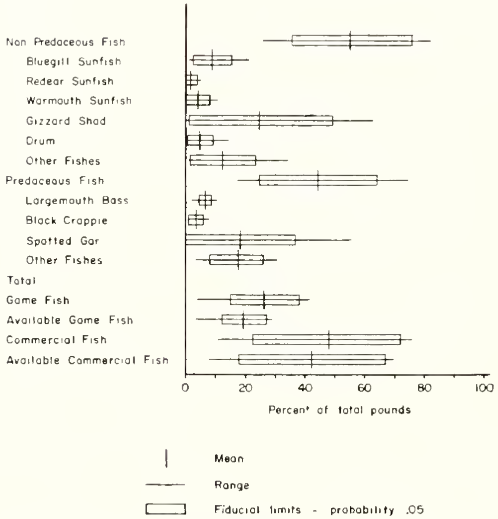

Fig. 17—Relative species composition of standing crops of fish in Louisiana backwater lakes.

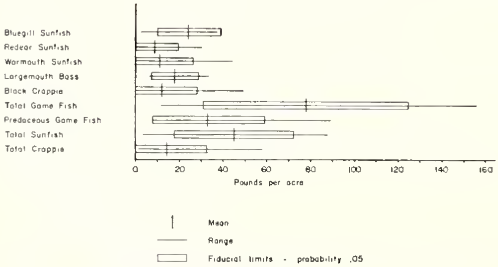

Fig. 18—Standing crops of available fish in Louisana back-water lakes.

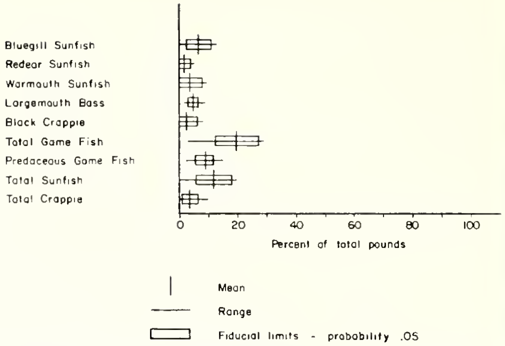

Fig. 19—Relative species composition of standing crops of available game fish (expressed as percent of total pounds of fish) in Louisiana backwater lakes.

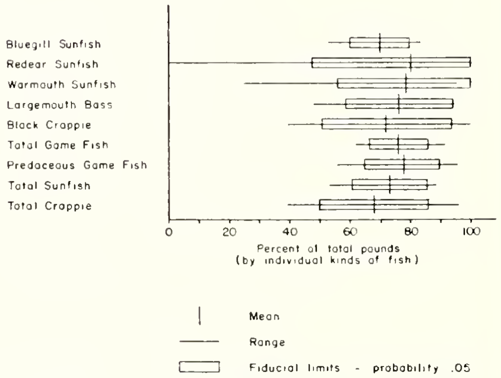

Fig. 20—Ratio of available game fish to the total standing crop for that kind of fish (expressed in percent) for Louisiana backwater lakes.

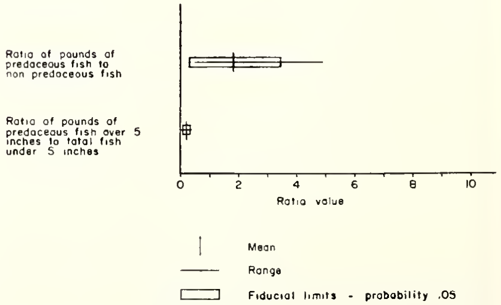

Fig. 21—Some predator - prey relationships in Louisiana backwater lakes.

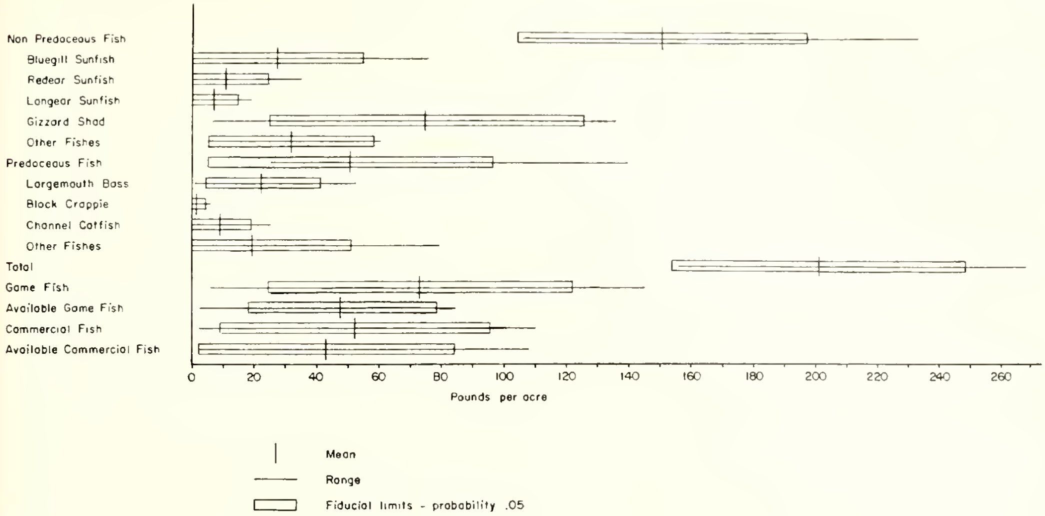

Fig. 22—Standing crops of fish in Mississippi River oxbowlakes in Louisiana.

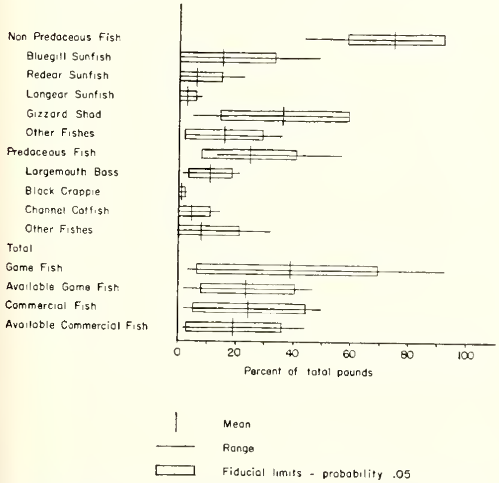

Fig. 23—Relative species composition of standing crops of fish in Mississippi River oxbow lakes in Louisiana.

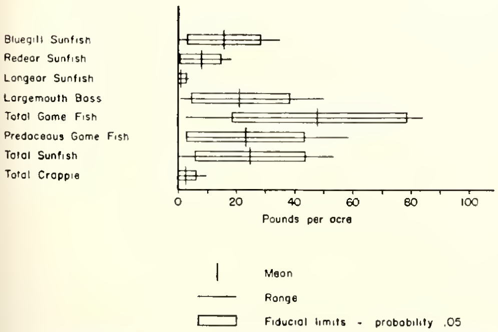

Fig. 24—Standing crops of available game fish in Mississippi River oxbow lakes in Louisiana.

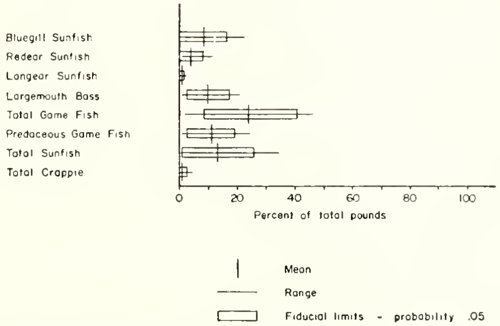

Fig. 25—Relative species composition of standing crops of available game fish (expressed as percent of total pounds of fish) in Mississippi River oxbow lakes in Louisiana.

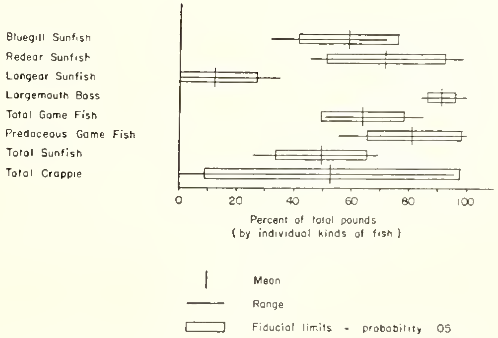

Fig. 26—Ratio of available game fish to the total standing crop for that kind of fish (expressed in percent) for Mississippi River oxbow lakes in Louisiana.

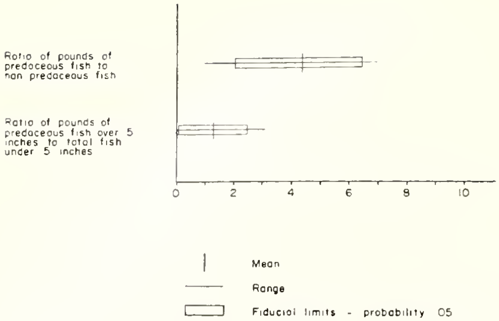

Fig. 27—Some predator-prey relationships in Mississippi River oxbow lakes in Louisiana.

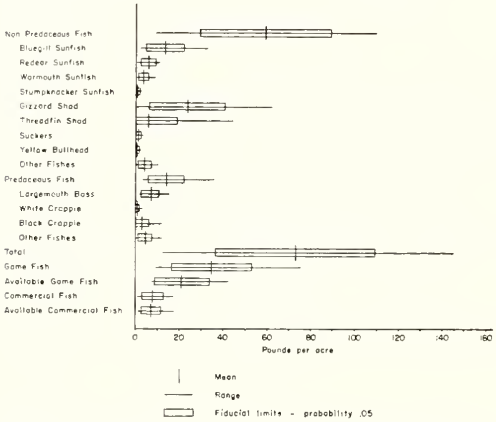

Fig. 28—Standing crops of fish in Louisiana impoundments.

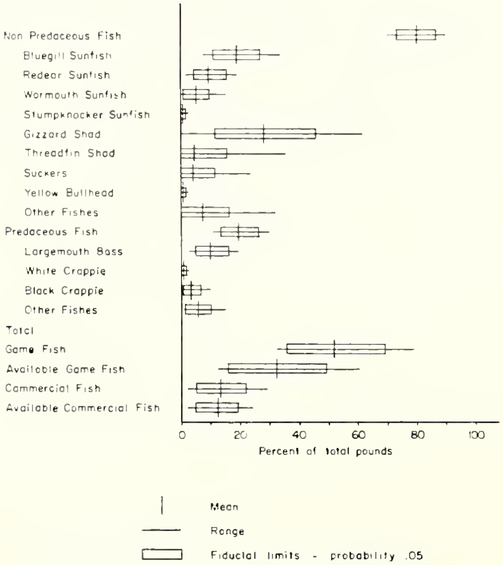

Fig. 29—Relative species composition of standing crops of fish in Louisiana impoundments.

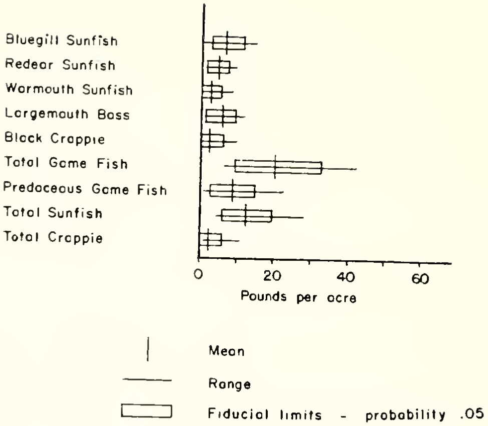

Fig. 30—Standing crops of available game fish in Louisiana impoundments.

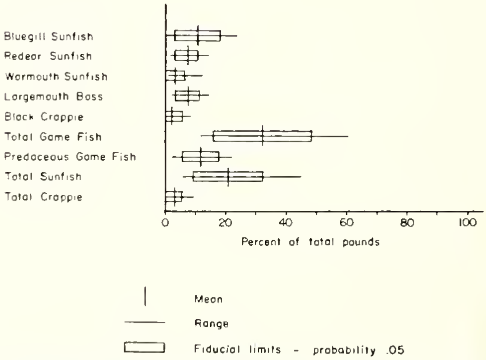

Fig. 31—Relative species composition of standing crops of available game fish (expressed as percent of total pounds of fish) in Louisiana impoundments.

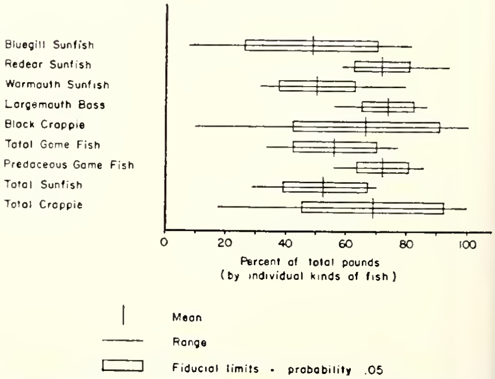

Fig. 32—Ratio of available game fish to the total standing crop for that kind of fish (expressed in percent) for Louisiana impoundments.

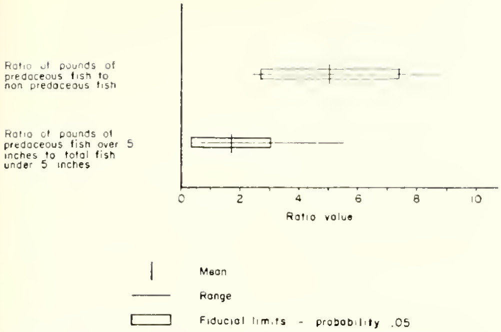

Fig. 33—Some predator-prey relationships in Louisiana impoundments.

marize the data for the impoundments. The same data are given for individual bodies of water in Tables 25 through 42.

The data contained in the above mentioned figures are self-explanatory with the possible exception of the data relative to the predator-prey relationships. The ratio of the total punds of predaceous fish to the total pounds of non-predaceous fish was determined. The mean ratio values obtained from the oxbow lakes and impoundments (4.3 and 5.0 respectively) are similar to the values obtained by Swingle (1950) from balanced populations in ponds. Swingle concluded that ratios in the range of 3.0 to 6.0 were the most desirable in order to have the proper balance in ponds. The mean value of 1.9 obtained from the backwater lakes is much lower then those obtained by Swingle.

TABLE No. 25

Standing Crops of Fish in Louisiana Backwater Lakes by Bodies of Water (Expressed as Pounds Per Acre)

	Colyell Bay	Dubloon Bayou	Bayou Courtableau Pits	Spring Bayou Backwater Area	Old River	Pearl River Backwater	Bayou Courtableau
Non-Predaceous Fish	74.4	134.1	143.8	539.5	419.2	175.5	126.1
Bluegill Sunfish	4.6	43.6	47.0	43.5	33.5	52.2	4.5
Redear Sunfish	.7	2.3	2.0	30.9	21.3	1.9	.1
Longear Sunfish	*	....	....	*	.1	5.9	.1
Warmouth Sunfish	12.4	55.0	2.4	2.4	.6	20.3	.7
Stumpknocker Sunfish	.2	15.3	.2	....	.2	11.5	.4
Orangespotted Sunfish	....	....	....	....	2.0	....	....
Green Sunfish	*	....	.2	....	*	....	....
Gizzard Shad	.9	....	90.4	408.5	261.1	.1	72.0
Threadfin Shad	....	....	1.6	....	11.8	....	....
River Herring	.3	....	....	.6	.2	....	....
Drum	8.0	1.6	....	12.9	73.3	21.1	16.9
Buffalo Fishes	13.2	....	....	40.0	2.5	24.8	31.4
Suckers	1.6	6.3	....	....	9.6	5.7	....
Yellow Bullhead	3.2	5.0	....	....	*	1.4	....
Black Bullhead	1.1	....	....	....	....	1.5	....
American Eel	1.3	....	....	....	.8	27.5	....
Golden Shiner	....	....	....	....	....	....	....
Paddlefish	9.4	....	....	....	....	....	....
Stripped Mullet	.7	5.0	....	....	.3	.7	....
Hogchoker	....	....	....	....	....	....	....
Carp	....	....	....	.6	....	....	....
Other Fishes	....	....	....	.1	1.9	.8	....
Predaceous Fish	67.4	388.6	84.0	111.4	114.5	158.3	243.0
Largemouth Bass	7.6	30.5	17.8	32.4	38.1	32.8	6.8
Kentucky Bass	....	....	....	....	....	1.9	....
White Crappie	6.7	....	....	8.4	*	....	....
Black Crappie	.7	17.3	15.2	50.3	2.0	9.0	2.0
Yellow Bass	....	....	....	1.7	7.9	....	....
White Bass	....	....	....	.1	....	....	1.0
Chain Pickerel	....	....	....	.2	....	....	....
Longnose Gar	....	....	....	....	1.9	.1	....
Shortnose Gar	....	....	....	2.0	1.9	....	14.0
Spotted Gar	18.0	179.5	8.4	1.1	12.5	62.5	202.9
Alligator Gar	....	57.0	12.8	1.1	....	....	3.2
Channel Catfish	27.8	8.8	....	....	50.1	14.9	1.1
Blue Catfish	1.6	....	....	14.2	....	12.2	5.2
Yellow Catfish	4.9	....	....	....	....	19.5	....
Bowfin	.4	95.5	29.8	....	....	5.3	6.8
Total	141.8	522.7	227.8	650.9	533.8	333.8	369.1
Game Fish	32.7	164.0	84.8	179.9	105.8	135.6	15.6
Available Game Fish	27.4	114.4	52.6	156.2	89.5	92.5	11.5
Commercial Fish	106.0	353.7	51.0	71.8	151.8	169.0	281.5
Available Commercial Fish	92.8	351.6	51.0	49.2	77.4	158.5	254.1

* Less than .05

TABLE No. 26

Relative species composition of standing crops in Louisiana backwater lakes by bodies of water (expressed as percent of total pounds).

	Colyell Bay	Dubloon Bayou	Bayou Courtableau Pits	Spring Bayou Backwater Area	Old River	Pearl River Backwater	Bayou Courtableau
Non-Predaceous Fish	52.5	25.7	63.1	82.9	78.6	52.6	34.2
Bluegill Sunfish	3.2	8.3	20.6	6.7	6.3	15.6	1.2
Redear Sunfish	.5	.4	.9	4.8	4.0	.6	*
Longear Sunfish	*	....	....	*	*	1.8	*
Warmouth Sunfish	8.7	10.5	1.1	.4	.1	6.1	.2
Stumpknocker Sunfish	.1	2.9	.1	....	*	3.5	.1
Orangespotted Sunfish	....	....	....	....	.4	....	....
Green Sunfish	*	....	.1	....	*	....	....
Gizzard Shad	.6	....	39.7	62.8	48.9	*	19.5
Threadfin Shad	....	....	.7	....	2.2	....	....
River Herring	.2	....	....	.1	*	....	....
Drum	5.6	.3	....	2.0	13.7	6.3	4.6
Buffalo Fishes	9.3	....	....	6.1	.5	7.4	8.5
Suckers	1.1	1.2	....	....	1.8	1.7	....
Yellow Bullhead	2.3	1.0	....	....	*	.4	....
Black Bullhead	.8	....	....	....	....	.4	....
American Eel	.9	....	....	....	.1	8.2	....
Golden Shiner	....	....	....	....	....	....	....
Paddlefish	18.7	....	....	....	....	....	....
Stripped Mullet	.5	1.0	....	....	.1	.2	....
Hogchoker	....	....	....	....	....	....	....
Carp	....	....	....	.1	....	....	....
Other Fishes	....	....	....	*	.4	.2	....
Predaceous Fish	47.5	74.3	36.9	17.1	21.4	47.4	65.8
Largemouth Bass	5.3	5.8	7.8	5.0	7.1	9.8	1.8
Kentucky Bass	....	....	....	....	....	.6	....
White Crappie	4.7	....	....	1.3	*	....	....
Black Crappie	.5	3.3	6.7	7.7	.4	2.7	.5
Yellow Bass	....	....	....	.3	1.5	....	....
White Bass	....	....	....	*	....	....	.3
Chain Pickerel	....	....	....	*	....	....	....
Longnose Gar	....	....	....	....	.3	*	....
Shortnose Gar	....	....	....	.3	.4	....	3.8
Spotted Gar	12.7	34.3	3.7	.2	2.3	18.7	55.0
Alligator Gar	....	10.9	5.6	.2	....	....	.9
Channel Catfish	19.6	1.7	....	....	9.4	4.5	.3
Blue Catfish	1.1	....	....	2.2	....	3.7	1.4
Yellow Catfish	3.4	....	....	....	....	5.8	....
Bowfin	0.2	18.3	13.1	....	....	1.6	1.8
Total	....	....	....	....	....	....	....
Game Fish	23.0	31.4	37.2	26.1	19.8	40.6	4.2
Available Game Fish	19.3	21.9	23.1	24.0	16.8	27.7	3.1
Commercial Fish	74.7	67.7	22.4	11.0	28.4	50.6	76.3
Available Commercial Fish	65.4	67.3	22.4	7.6	14.5	47.5	68.8

* Less than .05

TABLE No. 27. Standing crops of available game fish in Louisiana backwater lakes by bodies of water (expressed as pounds per acre).

	Colyell Bay	Dubloon Bayou	Bayou Courtableau Pits	Spring Bayou Backwater Area	Old River	Pearl River Backwater	Bayou Courtableau
Bluegill Sunfish	3.0	36.2	28.4	34.2	26.3	36.8	2.4
Redear Sunfish	.6	1.9	2.0	30.3	20.8	1.9	.0
Longear Sunfish	**	**	**	**	.0	1.0	.1
Warmouth Sunfish	11.9	43.9	.6	2.3	.5	17.7	.6
Stumpknocker Sunfish	.2	5.6	.0	**	.0	3.6	.0
Orangespotted Sunfish	**	**	**	**	.3	**	**
Green Sunfish	**	**	.0	**	**	**	**
Largemouth Bass	6.2	14.8	8.6	30.6	33.2	26.0	6.3
Kentucky Bass	**	**	**	**	**	.4	**
White Crappie	4.9	**	**	7.9	**	**	**
Black Crappie	.7	12.0	13.0	49.2	.8	5.1	1.1
Yellow Bass	**	**	**	1.6	7.7	**	**
White Bass	**	**	**	.1	**	**	1.0
Chain Pickerel	**	**	**	.2	**	**	**
Total Game Fish	27.4	114.4	52.6	156.2	89.5	92.5	11.5
Predaceous Game Fish	11.7	26.8	21.6	89.4	41.7	31.5	8.4
Total Sunfish	15.7	87.6	31.0	66.8	47.8	61.0	3.1
Total Crappie	5.5	12.0	13.0	57.1	.8	5.1	1.1

** All sizes did not occur in the samples or occurred only in trace amounts.

TABLE No. 28. Relative species composition of standing crops of available game fish (expressed as percent of total pounds of fish) in Louisiana backwater lakes by bodies of water.

	Colyell Bay	Dubloon Bayou	Bayou Courtableau Pits	Spring Bayou Backwater Area	Old River	Pearl River Backwater	Bayou Courtableau
Bluegill Sunfish	2.1	6.9	12.5	5.3	4.9	11.0	.7
Redear Sunfish	.4	.4	.9	4.7	3.9	.6	.0
Longear Sunfish	**	**	**	**	.0	.3	.0
Warmouth Sunfish	8.4	8.4	.3	.4	.1	5.3	.2
Stumpknocker Sunfish	.1	1.1	.0	**	.0	1.1	0
Orangespotted Sunfish	**	**	**	**	.1	**	**
Green Sunfish	**	**	.0	**	**	**	**
Largemouth Bass	4.4	2.8	3.8	4.7	6.2	7.8	1.7
Kentucky Bass	**	**	**	**	**	.1	**
White Crappie	3.4	**	**	1.2	**	**	**
Black Crappie	.5	2.3	5.7	7.6	.2	1.5	.3
Yellow Bass	**	**	**	.2	1.5	**	**
White Bass	**	**	**	.0	**	**	.3
Chain Pickerel	**	**	**	.0	**	**	**
Total Game Fish	19.3	21.9	23.1	24.0	16.8	27.7	3.1
Predaceous Game Fish	8.3	5.1	9.5	13.7	7.8	9.4	2.3
Total Sunfish	11.0	16.8	13.6	10.3	9.0	18.3	.8
Total Crappie	3.9	2.3	5.7	8.8	.2	1.5	.3

**All sizes did not occur in the samples or occurred only in trace amounts.

TABLE No. 29

Ratio of available game fish to the total standing crop for that kind of fish (expressed in percent) for Louisiana backwater lakes by bodies of water.

	Colyell Bay	Dubloon Bayou	Bayou Courtableau Pits	Spring Bayou Backwater Area	Old River	Pearl River Backwater	Bayou Courtableau
Bluegill Sunfish	65.9	83.0	60.4	78.6	78.4	70.5	53.3
Redear Sunfish	85.7	82.6	100.0	97.9	97.5	100.0	.0
Longear Sunfish	**	**	**	**	.0	16.8	100.0
Warmouth Sunfish	96.7	79.8	25.0	93.8	82.4	87.2	85.7
Stumpknocker Sunfish	75.0	36.6	.0	**	.0	31.2	.0
Orangespotted Sunfish	**	**	**	**	13.6	**	**
Green Sunfish	**	**	.0	**	**	**	**
Largemouth Bass	82.1	48.5	48.3	94.4	87.1	79.3	92.7
Kentucky Bass	**	**	**	**	**	20.7	**
White Crappie	72.9	**	**	93.2	**	**	**
Black Crappie	100.0	69.4	85.5	97.2	39.3	56.3	55.0
Yellow Bass	**	**	**	93.9	97.9	**	**
White Bass	**	**	**	100.0	**	**	100.0
Chain Pickerel	**	**	**	100.0	**	**	**
Total Game Fish	83.8	69.8	62.0	91.9	84.7	68.2	73.7
Predaceous Game Fish	78.8	56.1	65.5	96.1	86.8	72.0	85.7
Total Sunfish	87.9	75.4	59.9	86.8	82.9	66.4	53.5
Total Crappie	75.3	69.4	85.5	97.1	39.3	56.3	55.0

** All sizes did not occur in the samples or occurred only in trace amounts.

TABLE No. 30

Some predator-prey relationships in Louisiana backwater lakes by bodies of water.

	Colyell Bay	Dubloon Bayou	Bayou Courtableau Pits	Spring Bayou Backwater Area	Old River	Pearl River Backwater	Bayou Courtableau
Ratio of Pounds of Predaceous Fish to Non-Predaceous Fish	1.1	.4	1.7	4.8	3.7	1.1	.5
Ratio of Pounds of Predaceous Fish Over 5 Inches to Total Fish Under 5 Inches	.1	.1	.3	.2	.3	.2	.3

TABLE No. 31

Standing Crops of Fish in Mississippi River Oxbow Lakes in Louisiana by Bodies of Water (Expressed as Pounds Per Acre)

	Lake Bruin	Lake St. Joseph	False River	Lake Concordia	Lake St. John	Lake Providence
Non-Predaceous Fish	106.4	142.3	158·5	130.3	133.0	233.3
Bluegill Sunfish	24.0	.8	17.7	75.5	32.2	10.3
Redear Sunfish	10.2	.2	.9	34.4	11.4	7.7
Longear Sunfish	2.5	.5	9·6	.5	8·4	18.5
Warmouth Sunfish	....	.2	.7	6.4	2.5	....
Stumpknocker Sunfish	....	....	.9	....	.9	.3
Orangespotted Sunfish	....	....	....	3.8	....	....
Gizzard Shad	34.3	80.1	116.1	6.6	75.9	135.4
Threadfin Shad	....	....	....	1.5	....	....
Drum	....	10.5	1.4	....	....	35.5
Buffalo Fishes	16.2	32.4	.3	....	....	19.3
Carp	10.0	10.5	9.6	....	....	....
Yellow Bullhead	....	5.9	.2	1.2	.6	....
Black Bullhead	7.6	1.2	.4	....	....	3.8
Madtoms	2	....	....	....	.1	....
American Eel	1.4	....	.4	.3	.3	....
Other Fishes	.3	....	.2	·3	.6	2.6
Predaceous Fish	138.8	27.1	39.1	25.7	41.2	33.5
Largemouth Bass	52.8	1.4	23.5	23.0	11.9	21.9
White Crappie	3.8	2.0	....	1.3	....	....
Black Crappie	5.5	1.1	.1	....	1.5	.9
Yellow Bass	.5	....	....	.2	2.8	3.1
Longnose Gar	48·0	....	....	....	....	....
Spotted Gar	2.1	16.4	....	.7	....	1.8
Shortnose Gar	5.5	....	....	....	....	....
Channel Catfish	1.7	4.8	15.2	....	24.8	5.9
Blue Catfish	19.1	1.4	....	....	....	....
Yellow Catfish	....	....	....	....	.1	....
Bowfin	....	....	.1	.6	....	....
Needle Fish	....	....	.3	....	....	....
Total	245.2	169.4	197.6	156·0	174.2	266.8
Game Fish	99.1	6.2	53.3	144.9	71.7	62.6
Available Game Fish	83.7	2.9	38·1	72.6	47.3	39.1
Commercial Fish	110.0	83.1	27.1	2.5	25.5	66.2
Available Commercial Fish	107.1	48.5	26.4	2.5	11.0	62.4

TABLE No. 32

Relative Species Composition of Standing Crops in Mississippi River Oxbow Lakes in Louisiana by Bodies of Water (Expressed as Per Cent of Total Pounds)

	Lake Bruin	Lake St. Joseph	False River	Lake Concordia	Lake St. John	Lake Providence
Non-Predaceous Fish	43.4	84.0	80.2	83.5	76.4	87.4
Bluegill Sunfish	9.8	.5	8.9	48.4	18.5	3.9
Redear Sunfish	4·2	.1	.5	22.0	6.5	2.9
Longear Sunfish	1.0	.3	4.9	.3	4.8	6.9
Warmouth Sunfish	....	.1	.4	4.1	1.4	....
Stumpknocker Sunfish	....	....	.5	....	.5	.1
Orangespotted Sunfish	....	....	....	2.4	....	....
Gizzard Shad	14.0	47.3	58.7	4·2	43.6	50.7
Threadfin Shad	....	....	....	1.0	....	....
Drum	....	6.2	.7	....	....	13.3
Buffalo Fishes	6.7	19.1	.1	....	....	7.2
Carp	4.1	6.2	4.9	....	....	....
Yellow Bullhead	....	3.5	·1	.7	.4	....
Black Bullhead	3.1	.7	.2	....	....	1.4
Madtoms	.1	....	....	....	.1	....
American Eel	.6	....	.3	.2	.2	....
Other Fishes	.1	....	.1	.2	.3	1.0
Predaceous Fish	56.6	16.0	19.8	16.5	23.6	12.6
Largemouth Bass	21.5	.8	11.9	14.7	6.9	8.2
White Crappie	1.5	1.2	....	·8	....	....
Black Crappie	2·2	.7	.1	....	.9	.3
Yellow Bass	.2	....	....	.1	1.6	1.1
Longnose Gar	19.6	....	....	....	....	....
Spotted Gar	.9	9.7	....	.4	....	.7
Shortnose Gar	2.2	....	....	....	....	....
Channel Catfish	.7	2.8	7.7	....	14.3	2.2
Blue Catfish	7.8	.8	....	....	....	....
Yellow Catfish	....	....	....	....	*	....
Bowfin	....	....	.1	.4	....	....
Needle Fish	....	....	.1	....	....	....
Total	....	....	....	....	....	....
Game Fish	40.4	3.6	27.0	92.9	41.1	23.5
Available Game Fish	34.1	1.7	19.3	46.5	27.1	14.7
Commercial Fish	44.9	49.1	13.7	1.6	14.7	24·8
Available Commercial Fish	43.7	28.7	13.3	1.6	6.3	23.4

* Less than .05

TABLE No. 33
Standing Crops of Available Game Fish in Mississippi River Oxbow Lakes in Louisiana by Bodies of Water (Expressed as Pounds Per Acre)

	Lake Bruin	Lake St. Joseph	False River	Lake Concordia	Lake St. John	Lake Providence
Bluegill Sunfish	16.2	.3	12.8	34.6	20.9	7.2
Redear Sunfish	8.1	.1	.4	17.4	9.0	7.5
Longear Sunfish	.6	.0	·6	.0	2.9	2.1
Warmouth Sunfish	**	*	.6	1.0	2·0	**
Stumpknocker Sunfish	**	**	.3	**	.3	.2
Orangespotted Sunfish	**	**	**	.0	**	**
Largemouth Bass	49.5	1.2	23.5	19.4	10.8	20.6
White Crappie	3.6	1.3	**	.1	**	**
Black Crappies	5.4	.0	.0	**	1.5	.7
Yellow Bass	.5	**	**	.2	.0	.8
Total Game Fish	83.7	2.9	38.1	72.6	47.3	39.1
Predaceous Game Fish	58.9	2.5	23·5	19.6	12.2	22·1
Total Sunfish	24.8	.4	14.6	53.0	35.0	17.0
Total Crappie	9.0	1.3	.0	.1	1.5	.7

* Less than .05
** All sizes did not occur in the samples or occurred only in trace amounts

TABLE No. 34
Relative Species Composition of Standing Crops of Available Game Fish (Expressed as Percent of Total Pounds of Fish) in Mississippi River Oxbow Lakes by Bodies of Water

	Lake Bruin	Lake St. Joseph	False River	Lake Concordia	Lake St. John	Lake Providence
Bluegill Sunfish	6.6	.2	6.5	22.2	12.0	2.7
Redear Sunfish	3.3	.1	.2	11.1	5.2	2.8
Longear Sunfish	.2	.0	.3	.0	1.7	.8
Warmouth Sunfish	**	*	.3	.6	1.1	**
Stumpknocker Sunfish	**	**	·1	**	.2	.1
Orangespotted Sunfish	**	**	**	.0	**	**
Largemouth Bass	20.2	.7	11.9	12.4	6·2	7.7
White Crappie	1.5	8	**	.1	**	**
Black Crappies	2.2	.0	.0	**	.8	.3
Yellow Bass	.2	**	**	.1	.0	.3
Total Game Fish	34.1	1.7	19.3	46.5	27.1	14.7
Predaceous Game Fish	24.0	1.5	11.9	12.6	7.0	8.3
Total Sunfish	10.1	.3	7.4	34.0	20.1	6.4
Total Crappie	3·7	.8	.0	.1	.8	·3

* Less than .05
** All sizes did not occur in the samples or occurred only in trace amounts

TABLE No. 35
Ratio of Available Game Fish to the Total Standing Crop For That Kind of Fish (Expressed in Percent) For Mississippi River Oxbow Lakes in Louisiana by Bodies of Water

	Lake Bruin	Lake St. Joseph	False River	Lake Concordia	Lake St. John	Lake Providence
Bluegill Sunfish	67.4	32.0	72.2	45.9	64·7	69.7
Redear Sunfish	79.4	80.0	44.4	50.5	78.9	97.8
Longear Sunfish	22.4	.0	6.3	.0	34.4	11.6
Warmouth Sunfish	**	14.3	85.7	15.6	81.1	**
Stumpknocker Sunfish	**	**	27.8	**	30.8	62.5
Orangespotted Sunfish	**	**	**	.0	**	**
Largemouth Bass	93.7	85.4	100.0	84.3	90.2	94 1
White Crappie	94.7	66·1	**	8.0	**	**
Black Crappies	97.3	.0	.0	**	95.7	75.0
Yellow Bass	100.0	**	**	100·0	.0	27.2
Total Game Fish	84.4	47.0	71.4	50.1	66.0	62.5
Predaceous Game Fish	94.2	55.2	99.6	80.5	75.2	85.4
Total Sunfish	67.8	25.5	49.1	44.0	63.2	46.3
Total Crappie	96.2	41.9	.0	8.0	95.7	75.0

TABLE No. 36
Some Predator-Prey Relationships in Mississippi River Oxbow Lakes by Bodies of Water

	Lake Bruin	Lake St. Joseph	False River	Lake Concordia	Lake St. John	Lake Providence
Ratio of Pounds of Predaceous Fish to Non-Predaceous Fish	.8	5.3	4.1	5·1	3.2	7.0
Ratio of Pounds of Predaceous Fish Over 5 Inches to Total Under 5 Inches	.1	1.3	.7	3.1	.5	1.6

TABLE No. 37

Standing Crops of Fish in Louisiana Impoundments by Bodies of Water (Expressed As Pounds Per Acre)

	Lake Bistineau	Corney Lake	Caddo Lake	Chicot Lake	Black Lake	Black Bayou Lake—1954	Black Bayou Lake—1956	Anacoco Lake
Non-Predaceous Fish	109.3	9.6	27.8	110.5	65.9	45.8	62·3	43.3
Bluegill Sunfish	17.8	3.6	2.5	33.0	9.4	13.3	8.9	21.3
Redear Sunfish	10.9	2.0	4.1	4.4	10.1	11.9	3.2	1.7
Longear Sunfish	*	*	.4	.2	.6	*	*	*
Warmouth Sunfish	3.8	.9	.6	6.5	2.3	9.7	2.8	1·9
Stumpknocker Sunfish	.7	*	.3	·2	1.1	.6	.1	.1
Orangespotted Sunfish	.1	....	.1	....	.2	....	*	....
Small Sunfish	.8	....	....	....	....	....	....	....
Other Sunfishes	.1	....	1.0	....	....	1.1	*	.5
Pirate Perch	.1	....	....	....	....	.1	....	....
Gizzard Shad	22.5	....	9.9	62.5	33.2	4.2	43.7	16.9
Threadfin Shad	44.1	....	.3	....	....	....	....	....
Drum	1.9	....	5.7	....	1.9	....	....	....
Buffalo Fishes	5.2	....	2.7	....	1.2	....	....	....
Suckers	1.1	3·1	.1	.4	2.3	2·5	1.3	.5
Yellow Bullhead	.3	....	.1	1.2	.2	.5	*	.1
Black Bullhead	....	....	*	.6	.8	1.6	.1	.3
Madtoms	*	*	*	....	....	....	....	....
American Eel	.1	....	*	.1	....	.3	....	....
Other Fishes	*	*	.1	1.5	2.6	....	2.2	....
Predaceous Fish	12.6	3.4	3.7	35.4	14.3	14 8	8.2	18.2
Largemouth Bass	6.2	1.8	1.7	16.2	2.0	9.6	5.0	12·0
Kentucky Bass	.1	.3	*	....	....	....	....	....
White Crappie	·1	....	.3	3.0	....	.3	1.3	.5
Black Crappie	2.4	.6	.2	11.7	.4	.1	1.0	5.3
Yellow Bass	.3	....	.7	....	....	....	....	....
Chain Pickerel	1.1	.6	.1	....	....	1.3	.3	*
Longnose Gar	1.4	....	....	....	4.1	1.5	....	.3
Shortnose Gar	.4	....	....	....	....	....	....	....
Spotted Gar	.7	....	....	2.8	1.6	....	....	.1
Alligator Gar	....	....	....	....	....	1.9	....	....
Channel Catfish	....	....	.6	....	1·3	....	....	....
Blue Catfish	....	....	....	.3	1·3	....	....	....
Yellow Catfish	.1	....	.1	....	3.5	....	....	....
Bowfin	....	....	....	2.1	....	....	.6	....
Total	122·0	13.0	31.5	145.8	80.1	60.6	70.5	61.5
Game Fish	44.1	9 9	11.9	75.1	26.1	48.0	22.6	43.3
Available Game Fish	20.7	7.0	6.5	42.5	12.3	37.3	8.6	31.4
Commercial Fish	11.0	3.1	9.3	6.7	18.3	8.0	2.0	1.3
Available Commercial Fish	11.0	3.1	5.8	6.7	18·2	8.0	2.0	1.3

* Less than .05

TABLE No. 39

Standing Crops of Available Game Fish in Louisiana Impoundments by Bodies of Water (Expressed As Pounds Per Acre)

	Lake Bistineau	Corney Lake	Caddo Lake	Chicot Lake	Black Lake	Black Bayou Lake—1954	Black Bayou Lake—1956	Anacoco Lake
Bluegill Sunfish	4.9	2.8	1.4	12.7	2.9	10.9	.7	14.6
Redear Sunfish	6.5	1.5	3.0	3.2	6.3	8.6	2.1	1.6
Longear Sunfish	**	**	.1	.0	.0	**	**	**
Warmouth Sunfish	1.3	.3	·3	4.1	1.2	7.6	1.3	.9
Stumpknocker Sunfish	.1	**	*	.0	.1	.4	.1	.1
Orangespotted Sunfish	.0	**	.0	**	.0	**	**	**
Small Sunfish	.0	**	**	**	**	**	**	**
Other Sunfishes	.1	**	.0	**	**	·0	**	.5
Largemouth Bass	4.7	1.2	1.0	11.2	1.7	8.3	4.0	8.3
Kentucky Bass	.1	.3	**	**	**	**	**	**
White Crappie	.1	**	.3	2.0	**	.3	.3	.5
Black Crappie	1·6	.3	.2	9.3	.2	.1	.1	4.9
Yellow Bass	.3	**	.2	**	**	**	**	**
Chain Pickerel	1.0	.6	.1	**	**	1.0	.0	**
Total Game Fish	20.7	7.0	6.5	42.5	12.3	37.3	8.6	31.4
Predaceous Game Fish	7.8	2.5	1.7	22.5	1.9	9·8	4.4	13.7
Total Sunfish	12.9	4.6	4.8	20.0	10.4	27.6	4.2	17.7
Total Crappie	1.7	·3	.5	11.3	.2	.4	.4	5.4

* Less than .05

**All sizes did not occur in the samples or occurred only in trace amounts.

TABLE No. 38
Relative Species Composition of Standing Crops in Louisiana Impoundments by Bodies of Water (Expressed As Per Cent of Total Pounds)

	Lake Bistineau	Corney Lake	Caddo Lake	Chicot Lake	Black Lake	Black Bayou Lake—1954	Black Bayou Lake—1956	Anacoco Lake
Non-Predaceous Fish	89.6	73.9	88.3	75.8	82.2	75.6	88.4	70.4
Bluegill Sunfish	14.6	27.6	8.0	22.7	11.7	22.0	12.6	34.6
Redear Sunfish	9.0	15.1	12.9	3.0	12.6	19.6	4.5	2.8
Longear Sunfish	*	*	1.4	.1	·7	*	*	*
Warmouth Sunfish	3.1	7.2	1.7	4·5	2.9	16.0	4.0	3.1
Stumpknocker Sunfish	.6	.3	.8	.1	1.4	1.0	.1	.2
Orangespotted Sunfish	*	....	.2	....	.2	....	*	....
Small Sunfish	.6	....	....	....	....	....	....	....
Other Sunfishes	.1	....	3.2	....	....	1.8	*	.8
Pirate Perch	.1	....	....	....	....	.2	....	....
Gizzard Shad	18.4	....	31.5	42.9	41.5	7.0	62.0	27.5
Threadfin Shad	36.2	....	1.0	....	....	....	....	....
Drum	1.5	....	18·0	....	2.4	....	....	....
Buffalo Fishes	4.3	....	8.5	....	1.5	....	....	....
Suckers	.9	23.8	.2	.2	2·8	4.1	1.8	.8
Yellow Bullhead	.3	....	.4	.8	.3	.9	*	.2
Black Bullhead	....	....	.1	.4	1.0	2.7	.1	.5
Madtoms	*	*	.1	....	....	....	....	....
American Eel	.1	....	.1	.1	....	.4	....	....
Other Fishes	*	*	.3	1.0	3.2	....	3.1	....
Predaceous Fish	10·4	26.1	11.7	24.2	17.8	24.4	11.6	29.6
Largemouth Bass	5.1	14.1	5.4	11.1	2.5	15.9	7.1	19·5
Kentucky Bass	.1	2.3	*	....	....	....	....	....
White Crappie	.1	....	1.0	2.0	....	.6	1.8	.8
Black Crappie	2.0	4.9	.7	8.0	.5	.2	1.4	8.6
Yellow Bass	.2	....	2.1	....	....	....	....	....
Chain Pickerel	.9	4.9	.3	....	....	2.2	.4	*
Longnose Gar	1·1	....	....	....	5.1	2.5	....	.5
Shortnose Gar	.3	....	....	....	....	....	....	....
Spotted Gar	.5	....	....	1.5	2·0	....	....	.2
Alligator Gar	....	....	....	....	....	3.1	....	....
Channel Catfish	....	....	2.0	....	1.7	....	....	....
Blue Catfish	....	....	....	.2	1.7	....	....	....
Yellow Catfish	.1	....	.2	....	4.4	....	....	....
Bowfin	....	....	....	1.4	....	....	.9	....
Total	....	....	....	....	....	....	....	....
Game Fish	36.2	76.2	37.7	51.5	32.5	79.2	32·1	70.4
Available Game Fish	17.0	54.0	20.5	29.1	15.3	61.6	12.2	51.1
Commercial Fish	9.0	23.8	29·4	4.6	22.8	13.2	2.8	2.1
Available Commercial Fish	9.0	23.8	18.4	4.6	22.8	13.2	2.8	2.1

* Less than .05

TABLE No. 40
Relative Species Composition of Standing Crops of Available Fish (Expressed As Percent of Total Pounds of Fish) in Louisiana Impoundments by Bodies of Water

	Lake Bistineau	Corney Lake	Caddo Lake	Chicot Lake	Black Lake	Black Bayou Lake—1954	Black Bayou Lake—1956	Anacoco Lake
Bluegill Sunfish	4.0	21.2	4.3	8.7	3.6	18.0	1.0	23.7
Redear Sunfish	5.3	11.3	9.6	2·2	7·8	14.3	3.0	2 6
Longear Sunfish	**	**	.3	.0	.0	**	**	**
Warmouth Sunfish	1.1	2.3	.9	2.8	1.5	12.6	1.8	1.5
Stumpknocker Sunfish	*	.3	.1	.0	.1	.7	.1	.2
Orangespotted Sunfish	.0	**	.0	**	.0	**	**	**
Small Sunfish	·0	**	**	**	**	**	**	**
Other Sunfishes	*	**	.0	**	**	.0	**	.8
Largemouth Bass	3.9	9.5	3.0	7.7	2.1	13.7	5.7	13.5
Kentucky Bass	*	2.0	**	**	**	**	**	**
White Crappie	*	**	1.0	1.4	**	.6	.4	.8
Black Crappie	1.3	2.6	.6	6.4	.2	.2	.1	8.0
Yellow Bass	.2	**	.6	**	**	**	**	**
Chain Pickerel	.8	4.9	.2	**	**	1.7	.0	**
Total Game Fish	16.9	54·0	20.5	29.1	15.3	61.6	12.2	51.1
Predaceous Game Fish	6.4	18.9	5.3	15.4	2.3	16.1	6.2	22.3
Total Sunfish	10.5	35.0	15.2	13.7	13.0	45.5	6.0	28.8
Total Crappie	1.4	2.6	1.5	7.8	.2	.7	.6	8.8

* Less than .05
**All sizes did not occur in the samples or occurred only in trace amounts.

TABLE No. 41
Ratio of Available Game Fish to the Total Standing Crop For That Kind of Fish (Expressed in Percent) For Louisiana Impoundments by Bodies of Water

	Lake Bistineau	Corney Lake	Caddo Lake	Chicot Lake	Black Lake	Black Bayou Lake—1954	Black Bayou Lake—1956	Anacoco Lake
Bluegill Sunfish	27.7	76.9	53.8	38.5	30.9	81.6	7.9	68.5
Redear Sunfish	59.6	74.6	74.9	71.6	62.0	72.8	65.6	94.1
Longear Sunfish	**	**	18.2	.0	.0	**	**	**
Warmouth Sunfish	35.4	32.1	49.1	63.1	51.4	79.1	46.4	47.4
Stumpknocker Sunfish	7.1	100.0	11.5	.0	6.1	66.7	100.0	100.0
Orangespotted Sunfish	.0	**	.0	**	.0	**	**	**
Small Sunfish	.0	**	**	**	**	**	**	**
Other Sunfishes	100.0	**	.0	**	**	.0	**	100.0
Largemouth Bass	76.7	67.3	56.5	69.3	84.7	86.1	80.0	69.2
Kentucky Bass	100.0	88.9	**	**	**	**	**	**
White Crappie	100.0	**	100.0	67.8	**	100.0	23.1	100.0
Black Crappie	66.9	52.6	81.8	79.8	50.0	100.0	10.0	92.5
Yellow Bass	100.0	**	26.9	**	**	**	**	**
Chain Pickerel	95.9	100.0	66.7	**	**	77.6	.0	**
Total Game Fish	34.2	70.8	54.3	56.6	47.2	77.8	38.1	72.5
Predaceous Game Fish	77.4	72.5	56.4	73.2	78.9	85.6	57.9	77.0
Total Sunfish	37.8	69.9	53.6	45.0	44.0	75.4	28.0	69.4
Total Crappie	67.8	52.6	92.3	77.4	50.0	100.0	17.4	93.1

**All sizes did not occur in the samples or occurred only in trace amounts.

TABLE No. 42
Some Predator-Prey Relationships in Louisiana Impoundments by Bodies of Water

	Lake Bistineau	Corney Lake	Caddo Lake	Chicot Lake	Black Lake	Black Bayou Lake—1954	Black Bayou Lake—1956	Anacoco Lake
Ratio of Pounds of Predaceous Fish to Non-Predaceous Fish	8.6	2.8	7.6	3.1	4.6	3.1	7.6	2.4
Ratio of pounds of Fish over 5 inches to Total Fish under 5 inches	5.5	0.8	1.5	.9	1.1	.8	1.6	0.5

Ratio of pounds of

The ratio of the total weight of predaceous fish to non-predaceous fish is of value; however, this ratio does not show the weight of forage in the population on which the predators are dependent for food. In order to illustrate this relationship, the following values must be determined: (1) the total weight of predaceous fish of a size large enough to feed mainly on other fish or other forage animals (large crustaceans), and (2) the total weight of fish or other forage animals of a size small enough to be utilized for forage by the predators. Swingle calculated what he called a Y/C ratio where Y equals the total weight of those individuals in the forage group that are small enough to be eaten by the average size adult in the carnivorous group of fish, and C equals the total weight of the carnivorous fish. Sufficient information to allow the determination of exactly what size forage fish could be utilized by the predators in the populations sampled was not available. These predator-prey relationships are complex, especially in the case of fish populations containing many different kinds of fish. Some predators may utilize different size forage than others. Also, because a fish is of a size small enough to be utilized as forage doesn't necessarily make that fish available for forage. Some forage species may be easier to capture than others; therefore, it may take more of a certain kind of forage fish than another kind to support an equal weight of predators. Some forage species may frequent habitats in the lake that are not utilized by the predators. For example: are threadfin shad, which inhabit open water, as available to bass for forage as sunfish, which normally don't inhabit open water? However, on occasion, largemouth bass in some Louisiana waters school and feed on threadfin shad. Even though these predator-prey relationships are complex and hard to determine, some approximation of their values should be useful in understanding the dynamics of fish populations.

In order to make an approximation of the predator-prey relationship, the ratio of the total weight of predaceous fish over 5 inches in the population to the total weight of all fish under 5 inches was calculated. All kinds of fish were included in the prey group because it is probable that a small fish of the kind that are predaceous when of adult size could be utilized as forage. We reasoned that probably very few fish over 5 inches in length would be utilized as forage by the large predators. This breakdown is arbitrary and undoubtedly does not express the true relationship. However, if the assumption that few fish over 5 inches in length are utilized as forage is correct, then the amount of forage fish available for the predators over 5 inches in length is the maximum amount possible. If the possible errors in the ratio are kept in mind and it is realized that the amount of available forage is the maximum amount possible, the ratio should be of value for comparison purposes and for determining relationships in the population. It should also be realized that the amounts of available forage other than fish were not included in the predator-prey ratio inasmuch as it is not possible to sample crayfish and other crustaceans with rotenone.

The mean ratio value of the total weight of predaceous fish over 5 inches to total weight of fish under 5 inches for oxbow lakes and impoundments were 1.2 and 1.6. Swingle concluded that Y/C values in the range of 1.0 to 3.0 were the most desirable in order to have proper balance in ponds.

The mean ratio of the total weight of predaceous fish over 5 inches to total weight of fish under 5 inches was 0.2 for Louisiana backwater lakes. It seems improbable that predaceous fish in the backwater lakes could support themselves on less available forage (by weight) than they themselves make up in the population. The ratios were low for all lakes sampled. The ratios ranged from 0.1 to 0.3. We do not believe that these populations are unbalanced in the sense

Swingle defines balance. From a sport fishing standpoint, the fish populations occurring in the backwater lakes are very desirable. These lakes support an average of 102.6 pounds of game fish per acre of which 77.7 pounds are available game fish. From all indications the quality of the sport-fishing on the backwater lakes is excellent, and considering the lakes as a group, probably is much better than that on most other bodies of water in Louisiana. However, this is based on observations alone inasmuch as insufficient creel census data are available to accurately compare the quality of the sport fishing occurring on the different types of lakes. It would seem that the predaceous fish in the backwater lakes must be dependent on some type of forage other than fish. We believe that crayfish are important in the diet of large predators in these lakes. As stated previously, according to observations made by the project leader, largemouth bass utilize crayfish extensively for forage in some backwater habitats. Also, according to the project leader's observations, crayfish are extremely abundant during certain times of the year. In some of the backwater habitats, large commercial fisheries exist for crayfish. Investigations to clarify the predator-prey relationships in the backwater habitats are obviously needed.

Fairly large concentrations of fish occur in relatively small areas in some of the backwater lakes. A total of 974.2 pounds of fish, of which 474.9 pounds were game fish and 446.1 pounds were available game fish (Table 43), were recovered from a one acre sample taken from the Spring Bayou Backwater Area. This is a rather high poundage of game fish to occur in a natural body of water.

ACKNOWLEDGMENTS

The project leaders are indebted to Mr. Don Geagan, Louisiana Wild Life and Fisheries Commission, for providing the data on seven rotenone samples taken from Caddo Lake. Mr. Geagan also provided the data on the samples taken from Black Bayou Lake and Anacoco Lake.

TABLE No. 43

Summary of a One Acre Rotenone Sample of the Fish Population Occurring in the Spring Bayou Backwater Area

	Pounds Per Acre	% of Total Pounds	Pounds Per Acre Available Game Fish
Non-Predaceous Fish	662.5	68.0	....
Bluegill Sunfish	104.8	10.8	85.2
Redear Sunfish	83.2	8.5	81.3
Warmouth Sunfish	8.5	.9	8.1
Gizzard Shad	429.3	44.1	....
Buffalo Fishes	36.7	3.8	....
Predaceous Fish	311.7	32.0	....
Largemouth Bass	83.2	8.5	79.0
White Crappie	19.7	2.0	19.3
Black Crappie	173.8	17.8	171.5
Yellow Bass	.9	.1	.9
Chain Pickerel	.8	.1	.8
Shortnose Gar	7.3	.7	....
Spotted Gar	2.6	.3	....
Blue Catfish	23.4	2.4	....
Total	974.2	....	....
Game Fish	474.9	48.7	....
Available Game Fish	446.1	45.8	446.1
Commercial Fish	51.3	5.4	....
Available Commercial Fish	48.3	5.0	....

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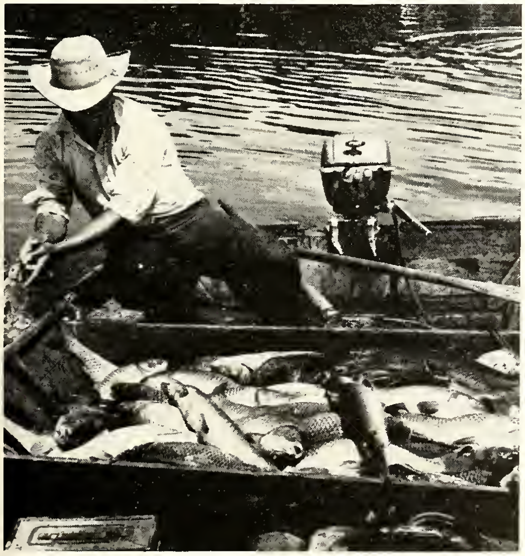


A large percentage of alligator gars may be seen in this haul of eliminated trash fish. These fish, removed by fishery biologists, prevented the growth and development of real pan fish for the angler. Re-stocking will make fishing ideal at this spot in time.

Dead trash fish are removed with scoop nets to prevent pollution of the waters. Their removal will make room for scientific re-stocking with game fish by fishery biologists with new stock from the State's hatchery.

GAME SECTION

JOHN D. NEWSOM
Pittman-Robertson Coordinator

CHARLES R. SHAW
Assistant Coordinator

In 1937 the Pittman-Robertson (Federal Aid in Wildlife Restoration) Act was passed by the United States Congress. This Act provided for Federal Aid to the States for the purpose of inaugurating wildlife research and development activities. Funds were made available through "ear marked" funds obtained from a 10% excise tax on sporting arms and ammunition levied at the manufacturers' level.

Appropriations to the individual states are based on total license sales and land area as this is related to total license sales and land area for the other states. The Act further provided that Federal monies must be matched with state funds on a basis of three-fourths Federal and one-fourth State on any project. Louisiana has been engaged in this program virtually since its inception.

During the past two years, Louisiana has continued its program of investigations and development for all species of game birds and animals.

The investigations project W-29-R has been concerned primarily with the accumulation of management information which will provide a more intelligent approach to game management, both from the standpoint of regulating the harvest and activities that will provide benefits to the species. All major species of game birds and game animals have been under study.

Several segments of the above project have been in operation for a number of years, and a vast amount of data has been accumulated. During the coming year job completion reports will be prepared on several segments, particularly deer, squirrel, quail and waterfowl. This does not mean that research on these species will be terminated; it simply means that it is felt that an accounting of our efforts must be made to determine what further research is needed and in which direction it should be aimed.

Development and management activities have been conducted under project W-30-D. These activities have consisted of deer trapping and transplanting, quail development, operation of management areas, waterfowl development, conducting hunts on management areas and others.

The deer trapping and transplanting program has been in progress in Louisiana since 1949, and it is apparent that most of the state has been adequately stocked with deer. As a result of this effort some areas have been opened to deer hunting during the past two years for the first time in many years. Most of North Louisiana will be able to enjoy open seasons on deer within the next two years. Therefore, justification for the continuation of this activity does not exist for any extended period.

Quail development has been conducted to a limited extent in many areas of the state. It is evident that, because of the rather expensive nature of quail development work, the P-R program can never, with current financial limitations, undertake a sufficient volume of work to be of any considerable value to the statewide quail population or to the sportsmen. Our activities have been aimed toward the establishment of model projects with the hope that private landowners, sportsmen groups and other interested individuals may wish to undertake similar work.

JOHN D. NEWSOM

A great deal of progress has been made in the waterfowl development program during the past two years. In addition to taking over some of the work that had been started with state funds under the Fish and Game Division, additional areas have been acquired for development. Waterfowl development activities in Louisiana have never received proper attention due to many reasons; however, with the termination of the deer trapping program and appropriations of additional monies, this aspect of wildlife development can be given some of the attention it deserves. If property could be purchased in fee simple title, this would greatly enhance waterfowl development possibilities in Louisiana.

One of the most readily available, and least utilized in the past, sources of benefit to the sportsmen of the state lies in the proper management of several hundred thousand acres of game lands presently under lease to the Commission as refuges and management areas. Insofar as upland game is concerned, all such areas should be opened for hunting on an annual basis. A start has been made in this direction and it is hoped that more progress can be made in the future.

The aims of the Pittman-Robertson Section of the Wildlife and Fisheries Commission are manifold. Primarily, the aims lie in an intelligent approach to the management of resident and migratory game birds and resident game animals in Louisiana. This can be attained only through a dynamic research program designed to meet the needs of ever-changing ecological conditions, and a development program designed to do the most good for those game species which lend themselves to both short and long term developmental programs.

Project W-29-R

STATE-WIDE WILDLIFE INVESTIGATIONS

DEER SEGMENT

Louis E. Brunett
Study Leader

Survival and Population of Deer

Shortly after the Red Dirt Game Management Area was set up, it became apparent that some system of indexing the deer population was needed. As an experiment, a deer track counting index system was tried. The system was begun in July of 1951 and consisted of making a count of deer tracks over a 31 mile route for a period of ten consecutive days in both early January and early August. These counts were made by two men in a jeep. All tracks were wiped out after each day's count. The length of time since the last rainfall was noted.

It was planned, at that time, to derive an index that would indicate the number of deer tracks per mile per hour. This number was to be obtained by multiplying the number of hours that the stretch of road was subject to deer tracking by the length of miles in the route, which would give a number that might be termed "hour/miles exposure." By dividing this number into the total number of tracks, the index number of tracks per hour per mile would be derived.

During the August counts, fawn tracks were tallied separately from adult tracks in order to determine a young/old ratio for that year. All deer observed on the route were recorded.

This system was followed until July, 1954, at which time the length of the index route was reduced from 31 to 6 miles.

During July of 1957 it was decided to begin the track count for August following the first rain after the 15th of July. Thus the fawn tracks, in the damp soil, should be more conspicuous to the observer.

The index numbers (Table I & II) indicates that the deer population on Red Dirt probably reached a peak in the fall of 1954 and has declined since that time. The indication of a population decrease is probably very near to actual happenings on Red Dirt, since deer browse conditions indicate that the peak population was reached about 1954; and fawn production was extremely low from 1953 to 1956. Although the total number of tracks decreased there was an increase in the percentage of fawn tracks (Table I). A deer hunt in the winter of '55-'56 reduced the herd by 100 buck deer and trapping operations have removed 550 since the winter of 1954. Even with the decrease in the population for the past several years, food conditions and the physical condition of the average deer still indicate considerable over-population.

TABLE I

August Deer Population Track Count On The Red Dirt Game Management Area

Date	% Adults	% Fawns	Index Number (Tracks/ Mile/Hour)
August, 1951	78	22	.10
August, 1952	81	19	.18
August, 1953	91	9	.28
August, 1954	89	11	1.18
August, 1955	92	8	1.07
August, 1956	88	12	.60
August, 1957	78	22	0.41

TABLE II

January Deer Population Track Count On The Red Dirt Game Management Area

Date	Index Number (Tracks/Mile/Hour)
January, 1951	.08
January, 1952	.14
January, 1953	.27
January, 1954	.89
January, 1955	.79
January, 1956	.39
January, 1957	.35

Results of Deer Corral

Two forty-acre deer enclosures, or corrals, were constructed on the Red Dirt Game Management Area in 1951 with the objective of determining annual increment; carrying capacity; key browse species; longevity of specific plants; and the effect of prolonged browsing. The enclosures were set up on areas that were typical of conditions throughout the game management area.

The south 40 corral had been stocked with two does and the north 40 was stocked to a buck and a doe. The doe of the north 40 had twin fawns in 1954. one of which died during the year. After the census of the area in 1957 the remaining fawn of the above doe was found dead. It had either starved to death or was injured during the census of the area. Both corrals were censused again in October, 1957 and it revealed two does in the south 40 and just the buck in the north 40. During the census of the north 40 the remains of the doe was found and it had probably starved to death.

CHARLES SHAW

The 20 permanent browse sample plots and 30 random sample plots in each enclosure are checked annually. In 1956 a total of 29 species were checked on the 20 permanent plots in the south 40. Seven had a browse index exceeding 100 percent which meant that those plants were over-browsed. When choice browse species exceed 100 percent and less palatable species show browsing or a high browse index, the area is over-populated and is considered in danger.

In 1957, 23 species were checked on the 20 permanent plots in the south 40 and 10 showed a browse index in excess of 100 percent (Table III). The 30 random plots of the south 40 showed 32 species checked with 14 that had a browse index exceeding 100 percent (Table III).

In 1957, 30 species were checked on the 20 permanent plots in the north 40 and 20 had a browse index of over 100 percent (Table III). In 1956, 36 species were recorded and 15 had a browse index exceeding 100 percent. In 1957 the 30 random plots of the north 40 showed 30 species checked of which 18 had a browse index of over 100 percent (Table III).

During the 1957 browse survey it was noted that three species (blackberry, sassafras, and mapleleaf haw) from the south 40 permanent plots and four species (rattan, sassafras, virginia willow, and yellow jessamine) from the north 40 permanent plots were not listed. These had a browse index exceeding 100 percent in 1956. It could be assumed that these were eliminated from the plots by heavy browsing.

In inspecting the vegetation that is available to deer in both corrals it can be easily seen that they are severely over-browsed and have been for some time.

TABLE III

Browse Species in the Deer Corrals with a Browse Index in Excess of 100 Percent in 1957

Browse Species	20 Permanent Plots	30 Random Plots	20 Permanent Plots	30 Random Plots
French Mulberry	225.0	212.5	200 0	225.0
Gallberry	175.0	225.0	225.0	225.0
Chokeberry	175.0	125.0	225.0	....
Maple	150.0	113.89	100.0	158.0
Red Bay	112.5	150.0	225.0	....
Smilax	225.0	225.0	157.5	225.0
St. Andrew's Cross	225.0	175.0	168.75	215.0
Wax Myrtle	135.41	....	190.67	214.28
White Bay	125.0	143.75	225.0	210.71
Yaupon	225.0	225.0	159.37	218.75
Blackberry	....	105.0	200.0	....
Mapleleaf viburnum	....	200.0	....	175.0
Sweetleaf	....	225.0	....	....
Virginia Willow	....	225.0	....	225.0
Water Oak	....	137.5	....	134.37
Aromatic Sumac	....	....	106.25	....
Azalea	....	....	159.37	100.0
Blackgum	....	....	108.33	....
Grape	....	....	225.0	....
Possumhaw viburnum	....	....	182.5	....
Sweet Gum	....	....	125.0	....
Winged Sumac	....	....	125.0	100.0
Winter Huckleberry	....	....	115.62	....
Poison Sumac	....	....	181.67	....
Crataegus	....	....	150.0	....
Dogwood	....	....	....	150.0
Poison Oak	....	....	....	125.0
Sassafras	....	....	....	225.0

Deer Browse Survey (Aldous Method) on the Red Dirt and Catahoula Game Management Areas

The deer browse survey of the Red Dirt Game Area for 1957 was based on 400 random sample plots. Of the 400 plots, 300 were taken on 32,000 acres of cattle free range, and 100 were taken on the 8,000 acre area containing an estimated 150 head of cattle. On the entire 400 plots a total of 40 species were listed, eight of which had a browse index exceeding 100 percent. The data for 1956 gave a total of 45 species, five of which had a browse index of over 100 percent. Those in 1957 that had a browse index of over 100 percent were French Mulberry (103.1 percent), Smilax (135.9 percent), mapleleaf viburnum (200.0 percent), rattan (150.5 percent), virginia willow (160.7 percent), yaupon (136.4 percent), strawberry bush (200.0 percent), and winged sumac (114.3 percent).

Of the 300 plots on the cattle-free range, there was a total of 35 species recorded. Five had a browse index exceeding 100 percent. The most important was probably smilax which occurred on 24 percent of the plots and had a browse index of 126.52 percent. Data on the 100 plots from the area containing both cattle and deer show a total of 34 species, 12 of which had a browse index of more than 100 percent. Again the most important species was probably smilax, which occurred on 29 percent of the plots and had a browse index of 159.91 percent. The data collected from the area subjected to cattle and deer shows there is considerable competition between the deer and cattle for browse.

The deer browse survey conducted on the Catahoula Game Management area was based on 420 random sample plots. Of the total plots 280 were checked on open range and 140 on cattle free range. On the 420 plots six species had a browse index of more than 100 percent. The plants were smilax (194.11 percent), Red Cedar (170.83 percent), St. Andrew's Cross (166.53 percent), blackberry (117.86 percent), winged sumac (102.02 percent), and water oak (100.21 percent).

Of the 140 plots checked on the stock-free area six species were found with a browse index exceeding 100 percent. They were rattan (200.0 percent), red cedar (175.0 percent), smilax (164.72 percent), water oak (118.75 percent), St. Andrew's Cross (116.96 percent), and winged sumac (106.25 percent).

Of the 280 plots checked on the open range area five species had a browse index that exceeded 100 percent. They were smilax (207.86 percent), St. Andrew's Cross (184.48 percent), red cedar (150.0 percent), blackberry (130.95 percent), and winged sumac (101.39 percent).

The 1956 data indicated two species that had a browse index that exceeded 100 percent. They were smilax and St. Andrew's cross. The over-browse conditions on Catahoula and Red Dirt were probably accentuated by the severe drouth during the 1956 growing season.

Deer Browse Survey (Aldous Method) of Madison, Tensas, and Concordia Parishes

Four hundred and twenty random sample plots were run in Concordia, Madison and Tensas Parishes. Those run in Concordia gave a total of 24 species with two having a browse index in excess of 100 percent. The browse index of wax myrtle (137.5 percent) is insignificant as it occurs in only 0.8 percent of the plots; however, smilax (106.92 percent) is very important since it occurred on 79.8 percent of the plots. Concordia contains only a moderate population of deer, while Madison and Tensas are considered overpopulated.

The data from Madison and Tensas Parishes show a total of 26 species, seven of which had a browse index of over 100 percent. Smilax is again the most important species, with a browse index of 151.07 percent, and occurring on 84.61 percent of the plots.

Summer Food Habits of Deer Utilizing Exclosures and Inclosures on Vegetational Sampling

The objective of this job of the deer research project is to determine the relative importance of herbaceaus shrubs, vines and trees in delta hardwood types for deer foods.

It is hoped to obtain some information on the damage deer may do to forest reproduction by browsing.

This study is being carried out on the forest of Fisher Lumber Company in Tensas Parish. Six exclosures 1¼ chains square, built to exclude deer, were constructed in June 1956.

Check plots of the same dimensions have been established adjacent to those areas. April of 1958 was designated as the first time to check the plots. They will be checked annually thereafter.

Vegetation Check in Exclosures and Controls

The primary purpose of this job is to attempt to determine the effect of browsing on plants and plant succession. There are fifteen exclosures each on the Red Dirt Game Management Area that are checked annually, employing Kreftings' method of recording vegetation by species, number of stems present and height class. Each exclosure contains five one mill-acre study plots with a similar arrangement outside as a control.

Comparing the data collected in 1957 from the exclosures and controls on the Red Dirt Game Management Area with that collected in 1956, very little difference was noted. When the grand total of all stems (2,346) recorded in the exclosures in 1956 is compared to the grand total of 2,230 for 1957 it shows a decrease of 116 stems for 1957. When the grand total of all stems checked on the controls for 1956 (2,080) is compared with the total of all stems checked on the controls for 1957 (1,970), there is a difference of 110 stems. The reduction in the total number of stems in both instances (inside and outside the exclosures) probably reflects the result of the drouth conditions during the growing season of 1956 or natural mortality due to over-crowding of the stems, instead of damage by deer.

The data collected from the 15 deer exclosures and controls on the Catahoula Game Management Area in 1957 showed considerable evidence of browsing. When the total number of stems (1,505) in the exclosures for 1956 are compared to the total number of stems (1,309) for 1957 it gives a reduction of 196. When the total number of stems (1,684) counted on the controls for 1956 are compared to those counted in 1957 (836) it shows a reduction of 848. Even though the differences are partially caused by the effect of drouth and natural mortality, the greater reduction in the number of stems for 1957 indicates heavy browsing.

Annual Inventory of Deer Areas

The objective of this phase of the deer research project is to attempt to determine those areas of the state which contain deer herds of sufficient size to warrant hunting. To obtain an index to the size of a herd present in a certain locality, sight records, track counts, deer use of salt licks, visual estimates of browsing and information from local people are used. Areas restocked with deer, upon completion of the mandatory five year closed season, are checked annually to determine if the herd is large enough to warrant hunting. Suitable unstocked areas are recommended for stocking.

Recommendations are made to the Louisiana Wildlife and Fisheries Commission on areas that should be opened for deer hunting.

Studies of Movements of Deer

To properly manage our deer herds we need to know more about their daily range and seasonal movement. On the Red Dirt Game Management Area two does have been marked with leather and plastic collars. Sight records will be kept on these deer and plotted on a map to try to determine their daily range and seasonal movement. We are attempting to capture, mark and release more deer of both sexes on Red Dirt and on the Chicago Mills Game Management Area to help carry out this phase of the deer project.

Reproductive Studies of the White Tail Deer

The objectives of this job are to determine the average fawn production, time of fawning, age and condition of breeding does. The Game Management Department of the Louisiana State University School of Forestry is cooperating in the study. During the winter of 1956 and 57 reproductive tracts were collected from 23 deer. These collections were made on Avery Island, Red Dirt Game Management Area, Pass-a-Loutre Public Shooting Grounds, and Tensas Parish.

Since the different sections of Louisiana have deer populations varying from sparse to heavily over-populated, it is felt that different studies will have to be made in each sector. Before a final analysis is made, much more data will have to be collected.

Investigations of Various Methods and Techniques for Capturing Deer by Use of Drugs

The capturing of deer by the use of live traps has been employed by Louisiana and other states for several years. This method of capturing deer has been successful under various conditions. With the idea in mind of capturing deer by administering a drug into the circulatory system of an animal, the Georgia Game and Fish Commission and the schools of Veterinary Medicine, Forestry and Pharmacy of the University of Georgia, Athens, Georgia, investigated the possibility of certain drugs induced into the animal by the use of a dart.

Nicotine salicylate possessed the most ideal characteristics and it was induced into the animal by a dart delivered from a converted Crossman air rifle.

In the early part of 1957 the Louisiana Wildlife and Fisheries Commission purchased four of the Crossman air rifles and darts for experimental purposes. A few deer were taken with the dart gun; but it was decided that the deer herds were too large to work with successfully and that the terrain did not lend itself to good hunting.

The dart guns have been traded for a new type gun that propels a syringe loaded with pure alkaloid nicotine. This gun and the chemical used is supposedly far more effective than the dart gun and nicotine salicylate.

Other tranquilizing drugs were investigated for the pos-

Mississippi rangers working with Louisiana Wild Life and Fisheries commission rangers along the Mississippi river. Rangers observing method of measuring deer at O'Possum Point Hunting club, East Carroll parish. Left to right: Harvey McMinn, Ackerman, Miss., ranger; Harold Reid, Ackerman, Miss., ranger; Chappell McGee, ranger for Louisiana Wild Life and Fisheries commission; Charles "Chili" Baur, Biological Aid, Wild Life and Fisheries commission; Jesse Osborne, Winona, Miss., ranger; Bob Mitchell, Eupora, Miss., ranger.

sibility of use in capturing deer. From the literature covering experiments, none seemed to be acceptable for this type of work.

Cooperative Deer Disease Study

This phase of deer research was added to the project on July 1, 1957 to obtain information as to the causative agents and possible controls of deer disease outbreaks in the southeastern states. It is a cooperative effort between eleven southeastern states and the University of Georgia. It was felt that the desired information could best be obtained by an agency such as the University of Georgia, School of Veterinary Medicine, which is equipped and staffed to conduct intensive studies.

The infectious phase of the procedures used will be conducted by Veterinarians and Pathologists from the University of Georgia and state personnel. Visits will be made to areas where deer are dying from unknown causes, necropsies will be performed and tissue specimens collected for bacteriological, viral, mycotic and parasitological studies. Histopathological studies will be made of all tissues collected. Transmissability of the disease will be made on deer, small laboratory animals and domestic goats and sheep. The carriers and vectors of the diseases encountered will be determined.

The toxicological phase of the procedures used will be conducted by making collections of known posionous plants where deer are dying and where necropsy indicates that death was related to poisoning. The ingesta of the necropsied animals will be chemically analysed. The poisonous plants will be fed to deer, goats and sheep to reproduce the syndrome. The plants will be chemically analysed and their extracts given to deer, small laboratory animals and domestic sheep and goats.

The nutritional phase of the procedures used will be conducted by determining the vitamin A content of the blood and the calcium and phosphorous content of the blood and bones.

A small die-off of deer occurred in Louisiana during July, August, and September of 1957 in the parishes of Madison, Tensas and on the Terzia Refuge in Morehouse Parish. The number that died was small and was nothing to get alarmed over. A Veterinarian and a Pathologist from the University of Georgia were called in to check the cause of death to the deer. After working seven days and part of seven nights in the field, 45 dead animals were found. The bodies of the dead animals were so badly decomposed that they could not be used. One freshly dead animal was found and necropsy was performed and the proper specimens collected. One sick animal was found which died shortly thereafter. A necropsy was performed and the proper specimens collected. Following laboratory examinations of the tissue specimens of the freshly dead animal, it was determined that the body had decomposed to the point that it could not be used. The laboratory examination of the tissues of the animal found sick revealed that it died of chronic arsenic poisoning.

Deer being released in Lincoln Parish.

Louisiana Wild Life and Fisheries commission personnel releasing deer in Ouachita parish.

Deer Transplanting Program

The purpose of the deer transplanting program of the Louisiana Wildlife and Fisheries Commission, Pittman-Robertson section, is to trap deer from overpopulated areas and release in suitable areas which have no deer present. It is well known that trapping will not remove enough deer from an overpopulated area to make any significant difference in total population.

During the trapping season of the winter of 1955-56 there was a total of 277 deer trapped. They were transported to various areas (Table IV) throughout the state and released. Of the total number trapped 112 were bucks and 165 does.

During the deer trapping season of the winter of 1956-57 there was a total of 263 deer trapped. Of the total trapped 101 were bucks and 157 does. Within the total number five deer (sex unknown at the present time) were taken at the Rucie Moore place.

DEER TRAPPING (MADISON AND TENSAS)

Dewey Wills
District Supervisor

C. T. Williams
District Biologist

Trapping operations for period covered in this report resulted in 213 deer being trapped. Of this number 33 were released in Catahoula Parish, 20 in LaSalle Parish, 37 in Vernon Parish, 33 in Bossier-Webster Parishes, Belleview Area, 32 in Webster-Bienville Parishes, Kepler Creek Area, 18 in Red River Parish, 25 released at trap site, and 15 died from trap injuries.

The doe deer ranged in weight from 25 pounds for a 5 months old doe to a maximum of 160 pounds for 4½ year old doe. The minimum and maximum range for trapped bucks was 30 pounds for a 5 months old buck to 145 pounds for ½ year old 8 point buck. Ages of all deer ranged from 5 months to 5½ years of age. Fifteen deer died during the trapping operation from self inflicted injuries which gave 7.5% mortality rate.

The sex ratio of trap deer was 6 does to each buck, among

TABLE IV

Deer Trapped and Released During 1955-56 Trapping Season

Total Number	Male	Female	Source	Release Point
36	15	21	Red Dirt — Catahoula G.M.A.	Bossier Parish
29	9	20	Red Dirt — Catahoula G.M.A.	DeSoto Parish
28	8	20	Red Dirt — Catahoula G.M.A.	Red River Parish
30	10	20	Red Dirt — Catahoula G.M.A.	E. Feliciana Ph.
32	9	23	Red Dirt G.M.A.	Grant Parish
32	12	20	Madison - Tensas Parishes	LaSalle Parish
3		3	Catahoula G.M.A.	Natchitoches Ph.
28	20	8	Red Dirt G.M.A.	Calcasieu Ph.
31	13	18	Madison - Tensas Parishes	Catahoula Ph.
7	5	2	Zemurry Park	St. Helena Ph.
4	1	3	Avery Island	Calcasieu Ph.
8	8	0	Zemurry Park	St. Helena Ph.
3	1	2	Zemurry Park	E. Feliciana Ph.
6	1	5	Madison - Tensas Parishes	LaSalle Parish
277	112	165		

TABLE V

Deer Trapped and Released During 1956-57 Trapping Season

Total Number	Male	Female	Source	Release Point
30	15	15	Red Dirt G. M. A.	Bossier Parish
15	6	9	Madison - Tensas Parishes	Webster Parish
18	6	12	Madison - Tensas Parishes	Webster Parish
32	7	25	Madison - Tensas Parishes	Webster Parish
20	9	11	Red Dirt G. M. A.	Union Parish
19	10	9	Red Dirt G. M. A.	Lincoln Parish
18	2	16	Madison - Tensas Parishes	Red River Parish
34	19	15	Red Dirt G. M. A.	Jackson Parish
15	6	9	Red Dirt G. M. A.	Richland Parish
37	12	25	Madison - Tensas Parishes	Vernon Parish
2	1	1	Avery Island	Calcasieu Parish
18	8	10	Zemurry Park	E. Feliciana Ph.
5	Sex unknown		Rucie Moore	Natchitoches Ph.
263	101	157		
21	Sex unknown		Wisconsin	Tensas Parish
284				

adults. Sex ratio among fawns was practically one to one, however 65% of total catch were fawns.

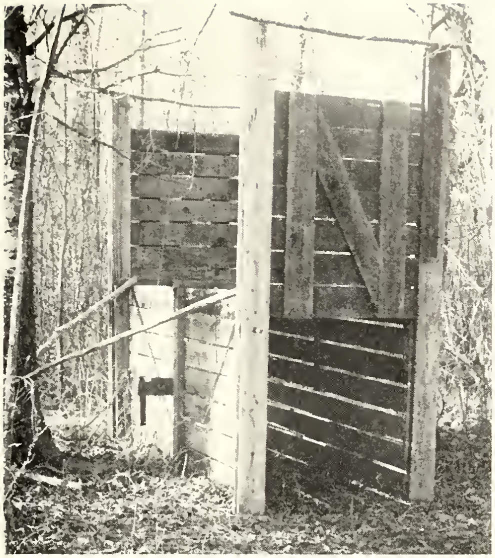
Following is table giving information on deer released during the period covered by this report.

Date of Release	Tot. No.	Male	Female	Source	Release Point
Jan. 1956	33	14	19	Chicago Mills Refuge-Madison	7½ Mi. N.E. of Aimwell Tower-Catahoula Parish
Jan., Feb., Mar., 1956	20	5	15	Chicago Mills Refuge-Madison	10 Mi. N.W. of Jena on Chickasas Creek-LaSalle Parish.
Jan., Feb., 1957	18	2	16	Chicago Mills Refuge-McLemore Plantation-Osceola Plant.	Red River-Bienville Parish Line.
Dec., '56-Jan., '57	33	12	21	Chicago Mills Refuge-McLemore Plantation.	Bossier-Webster Parish Line-Belleview Area.
Jan., 1957	32	6	26	Chicago Mills Refuge-McLemore Plantation-Osceola Plant.	Webster-Bienville Parish Line-Kepler Creek Area.
Nov., Dec., 1956	37	12	25	Chicago Mills Refuge.	Near Anacoco Vernon Parish.

Traps

Two types of traps were used in the trapping operation. A portable type trap, made of ¾″ pipe and 2″ netting (in place of 4½″ netting) was used as described in a bulletin written by the California Fish & Game Division. The box type trap was constructed of ¾″ pipe to a dimension of

Biologist aging deer.



Box type trap used to trap deer on the Chicago Mills Refuge.

and these were set with 2 wire hooks and triggered by a large rat trap.

The other traps were the standard wooden box type used throughout the southeast.

Several interesting but frustrating problems were encountered on the trap lines where the net traps were used. One problem which became very bothersome was that of rodent damage to the net in the traps. The damage was primarily caused by rabbits. Rabbits were observed chewing the net, causing damage to a height of 24 inches in some instances.

A sample of the rodent repellent (5% trinitrobenzene aniline (TWB—A) was obtained from the Fish & Wildlife Service, Wildlife Research Labratory, Denver, Colorado and was experimented with to a certain degree. This formulation, commonly called "Ringwood", is of the taste type and has been used by many states for protection of trees and shrubs against rabbit damage. The netting of several of the traps were coated with "Ringwood", but failed to repel the rabbits.

Another problem encountered on the trap lines where the net type traps were used, was that of "bait stealing" by small rodents. The areas trapped carried a high wood rat population and the rats were attracted to the trap site by the baits used. It was not uncommon for rats, with the help of birds, to clean bait. A number of rat nests were torn apart and on several

Transferring deer from handling crate into carrying crate.

7 feet long, 4 feet high and 3 feet wide. A 2 inch nylon mesh netting was laced to the pipe frame. Two mesh doors which slide on ½ inch pipe runner bars were placed at each end occasions one to two pounds of beans were found in the nests. Operation D—Con was conducted in an effort to eliminate this problem. This operation consisted of placing small amounts of D—Con around the trap sites and was a definite aid in coping with this problem.

Another minor problem was that of birds cleaning the trap site free of bait. The bob white quail was the chief nuisance in this respect.

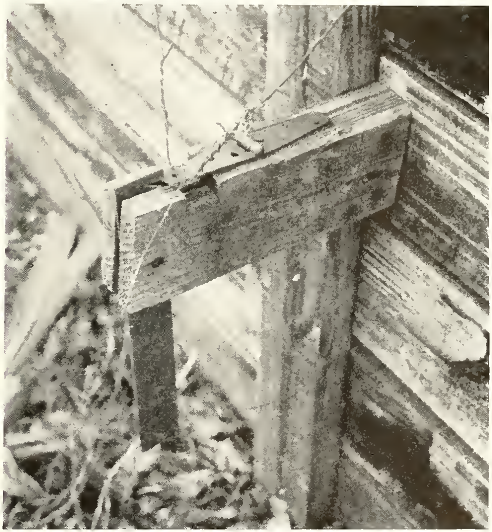
Baits

The primary bait used was soybeans which had been combined and was free of debris. Other baits used were horse-mule feed; shelled corn, and salt.

Deer Trapping On Zemurray Park

During the 1956-57 biennium, 34 deer were trapped on Zemurray Park. Of these 34, one was released in St. Helena Parish, twenty in East Feliciana and thirteen in Ouachita Parish. Both the net and wooden traps were used on this trapping operation and somewhat better success was had with the net type.

Deer traps have proven to be the best of three methods employed to date to remove deer from this area. Three attempts were made in May of 1956 to remove these animals by means of a large net measuring 200 ft. by 8 ft. with 4 in. square mesh. This net was stretched through the more dense wooded area and attached to an overhead wire by clothes-pins. A drive line of approximately 30 people was formed. The drivers moved through the area where deer were known to bed down during the day, each driver keeping in sight of the one on either side. After three attempts to push deer into this net this procedure was abandoned. It was learned that deer will quickly panic when being herded and cannot be moved along a predetermined route such as cattle are driven. During the entire operation only one animal was caught in the net.



Trigger on box type deer trap.

Two attempts were made to remove deer using the headlight and dart gun technique (described elsewhere in this biennial report). On the first attempt, March, 1957, only

Ear tagging deer that has been trapped.

twelve deer were seen during a four hour search with headlights and none could be approached closely enough for a shot. Twenty-five were sighted on the second try during the following month and a shot was taken at one but the dart missed. An attempt will be made in the near future to take deer with a new type dart gun which has greater range than the one used earlier.

Beaver Trapping and Transplanting

A full-time trapper is employed to trap beaver that have become a nuisance in the Florida Parishes, primarily E. Feliciana, St. Helena, Tangipahoa, Washington, St. Tammany, Livingston and East Baton Rouge, These animals are taken alive and released in areas where they are more likely to become an asset rather than a liability.

During the 1956-57 biennieum, 56 beaver have been trapped and successfully released in more desirable areas. Twenty-one of these animals were trapped in 1956 and released in the following sites: West Feliciana (vicinity of Angola) - 3; Webster - 11; Tensas (Sticks Bayou) - 4; and LaSalle (Bayou Funny Lewis) - 3. During 1957, the following 35 were released: Morehouse (Coulee Game Management Area) - 6; Bienville (Lake Bistineau) - 4; Beauregard (Whiskey Clatta Creek) - 3; Beauregard (Sugar Creek) - 5; Lincoln - 6; Union (2 miles N. E. Haille) - 4; Monroe (vicinity) - 2; and Webster (Sherman Creek) - 5.

Considerable rainfall has hampered the trapper, particularly during 1957. Some beaver have been lost in holding pens, which must necessarily be kept in the edge of a running stream, due to flash floods on or above the stream. Eight were lost during handling and transportation.

Charles Baur, Biological Aid, and George Files, trapper, releasing beaver on the Coulee Game Management area in Morehouse parish.

A cooperative study between Louisiana Wild Life and Fisheries and Louisiana State University is now being conducted to study the effects of beaver releases made in the past. A graduate student in game management is paid and furnished transportation by the La. Wild Life and Fisheries Commission, in order to learn what benefit, or harm, the people of Louisiana are experiencing by these releases. The study will not be finished until August of 1958, and is yet too early to draw any conclusions.

There were two interesting observations worth noting. During the 1955-56 trapping operation a 35 pound fawn (buck) was trapped, ear tagged, and released at the trap site. During the 1956-57 trapping operation the buck was retrapped near the release point. His weight was 135 pounds and his antlers were barely an inch in length. Also, an eight point buck was trapped, ear tagged, and released at the trap site on December 12, 1956. This deer was killed approximately one-fourth mile from trap site on December 28, 1956.

MIGRATORY WATERFOWL SEGMENT

Morton M. Smith
Study Leader

The waterfowl research study was first initiated on July 1, 1949 under the direction of Mr. Richard Yancey. In January of 1957 the present study leader took over direction of the investigation. Since the inception of the study a great deal of information has been gathered on Louisiana waterfowl from both ground and aerial observations. A review of the past two years findings is included in the following report.

Waterfowl Population Studies

The size and location of the statewide waterfowl population was determined by aerial inventories run twice each month from September through March. These studies have been carried on since 1951 and important information on the distribution, time of migration, local movements, and availability of the various ducks and coots to the hunter is being amassed.

1956

The census information gathered from September 1956 through March 1957 was similar to that obtained in the previous five years work. The first census of the year was flown in early September and as usual blue winged teal were the most abundant species in the state with the greatest portion of them found in the coastal marshes. Several thousand pintail, wood duck, and mottled duck were recorded also. The latter two species are found year round in Louisiana—the mottled duck nesting in the coastal marshes and the wood duck in the lowland forest of the state.

Duck numbers gradually increased throughout September and early October due largely to gains in the blue wing population. Pintail and green wing teal numbers were also on the increase. By mid October the blue wing teal population had reached its peak of 220,000 and pintail numbers were approaching the 100,000 mark.

Duck numbers mounted slowly during October and early November. The annual mass flight of blue and snow geese arrived here as usual during the last week of October.

Beginning on November 7 and lasting through November 10th, a flight of ducks swept into Louisiana that changed the duck picture completely. It is estimated that a million and a quarter ducks arrived during the three day period.

This flight represented the first major arrival of mallards and diving ducks and along with it came additional numbers of gadwall, pintail, green winged teal, shovellers, and coots. Meanwhile the blue winged teal and some balpate had departed the state. The waterfowl population as a result of the flight jumped to an estimated 1,800,000 ducks by November 15. In addition about 415,000 geese and 113,000 coot were wintering in the state by mid November.

Waterfowl numbers continued to climb and the peak winter population was tallied on December 1. Numbers remained high throughout December and most of January with little change in the species composition of the flock.

By early March, many of the wintering ducks had departed for the nesting grounds. Mallard and pintail numbers were low while blue wings were again on the increase as they swept back northward from Central and South American areas. On March 5 a great concentration of scaup was found in the Gulf off southwest Louisiana. Starting at Pointe au Fer and extending west to the Sabine River a series of large flocks of ducks were found off the coast.

A conservative estimate places the number observed at 1,000,000 scaup.

The remaining spring inventories of 1957 show a steady decline in all ducks except blue wings and shovellers which reached peak numbers for the whole season in late March. These spring inventories point out the difficulties in evaluating populations of waterfowl that use the flyway in migration, but winter out of the flyway and out of the continental United States.

The condition of the state habitat in the fall of 1957 was unlike that found in any previous year of study. Louisiana had more rain during the fall and early winter than at any time since this study was started. North Louisiana bottomlands were flooded and rice fields and coastal areas had far more water than usual. Hurricane Audrey in June of 1957 made great changes in the marshes of southwest Louisiana. Normally dense stands of vegetation in the interior marshes were opened up by the killing action of salt water. These openings plus continued high tides and rains created new waterfowl areas in regions previously little used by ducks. Conditions in southeast Louisiana were generally improved over previous years with the exception of the delta marshes at the mouth of the Mississippi River. The river remained high virtually the entire summer and fall inundating the food producing flats of the delta throughout the growing season. Production of waterfowl food was poor as a result. The hurricane tide of September 1956 had swept much of the area clean of vegetation and habitat recovery to date has been slow. Throughout the fall continued high tides reduced waterfowl usage of much of the sea rim area. These factors combined with a past and present high nutria population have resulted in a denuded and less preferred waterfowl area. In addition weather and water conditions in other states influenced Louisiana's waterfowl population. The essentially dry years in the central states were ended by the abundant rain of the summer and fall. It is believed that many ducks using the Mississippi Flyway during the last few years were able to shift back to areas farther west. A great increase in mallard numbers was reported in South Dakota and other central states. Numbers remained high in the above regions into mid December. The first major flight of mallards did not leave South Dakota until about December 10. Although cold weather occurred prior to mid December in these upper states snow must cover the feeding grounds of the mallards before they will depart for more southerly regions. Unless the relatively late winters of the last few years give way to more severe fall weather with much snow in the north central states, Louisiana may be faced with a continuing reduction in the number of mallards wintering here. And it is the mallard that makes the difference between good or poor hunting seasons statewide.

Despite the above factors the Louisiana waterfowl population in 1957 was about the same size as that recorded for 1956. The distribution of the ducks however was much altered from that of previous years. Southwest Louisiana held a great majority of the state waterfowl population throughout the fall and winter of 1957. Many areas opened up by the storm tides were heavily utilized by ducks. These same areas in years prior to the storm held few if any ducks. The concentration of ducks in new areas, the shortage of mallards in the state until mid December, and the fact that the scaup concentrated in large bay and gulf areas led the hunter to believe that fewer ducks came to Louisiana last season. The aerial inventory figures indicate such was not the case.

One other aspect of the Louisiana fall and winter waterfowl population is worthy of note. In previous years virtually the entire blue winged teal population has departed by the first week in November. This year a flock of over 100,000 blue winged teal wintered in Louisiana. No reason for this is known in view of the fact that the winter in Louisiana was more severe in 1957 than in the immediately preceding years.

The migration of geese in 1957 was somewhat different from that of 1956. The large flights of Canadian and white fronted geese did not arrive in the state until very late this year—not until about December 11 or 12th. White front numbers were similar during the two years of this report but Canadian geese had jumped from a high of 7000 in 1956 to an estimated 10,000 in 1957. With the exception of less than 200 Canadas in southeast Louisiana the entire remaining flock of these geese and all the white fronts were found in southwest Louisiana. The regular flight of blues and snows arrived in Louisiana during the last week in October. The number of blues and snows in our marshes were about the same during both years of this report. The coot population showed a substantial increase in 1957. It is believed that the abundance of fresh water in the latter year contributed to a higher winter population of coots (poule-deau).

Flyway Waterfowl Conditions

The Mississippi Flyway waterfowl distribution and migration study was in operation during 1956 and the Louisiana inventory work was coordinated with the work of the other thirteen flyway states.

During December of 1956 an estimated 9,000,000 ducks were recorded in the Mississippi Flyway. Louisiana reported two and a half million of these ducks. While the inventory figures are only estimates they give an indication of the importance of Louisiana in the Mississippi Flyway.

Some aspects of the duck picture are interesting. Of the estimated 6,000,000 mallards in the flyway only 10% were found in Louisiana in early December. As usual the big mallard states in 1956 were Arkansas and Illinois. Other than mallards it was found that our state wintered the majority of the puddle ducks found in the flyway. About 80% of the pintail, 90% of the green winged teal, 85% of the gadwald and over half of the flyway's baldpate were found in Louisiana —largely in the coastal marshes.

The picture on geese was more varied. Louisiana wintered almost the entire flyway population of blue and snow geese and white fronted geese. Of the total flyway population of Canada geese Louisiana had about two per cent in early December of 1956. Illinois is far and away the most important wintering grounds for the Canada goose with about two-thirds of the Flyway flock.

Waterfowl Hunter Kill Surveys 1956

The kill of ducks, geese, and coots in Louisiana is analyzed through a system of hunter bag checks at standard locations over the state. The areas checked and the method used were essentially the same in both 1956 and 1957. In both years the aerial inventories indicated Louisiana was wintering more ducks than in any previous study year, yet the hunter kill was the lowest recorded.

During the split season of 1956 12,235 waterfowl were recorded in 8,929 hunter bag checks made by biologists of the Louisiana Wildlife and Fisheries Commission.

The table on composition of the kill shows that mallards were the single most important species making up 44% of the kill. Other important species in the bag were the pintail 11.2%, gadwall 9.3%, greenwinged teal 8.8%, ringneck 4.8% shoveller 4.1% and blue winged teal 3.9%.

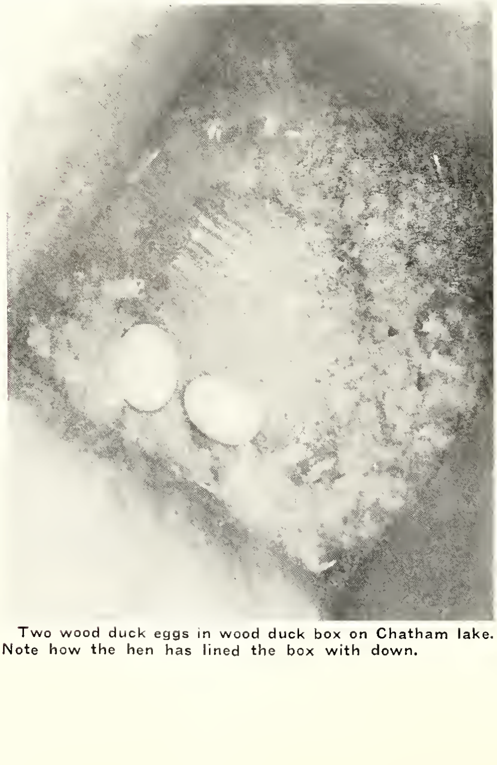
Waterfowl hunting was poorer in 1956 (1.23 waterfowl per man per day) than in any preceding study year. The bag checks for 1956 again provide evidence that good hunting depends on more than just high waterfowl populations. Within limits it is apparent that the distribution of the ducks is far more important to the Louisiana hunter than the size of the state waterfowl population.

In the 1957 hunting season just completed, commission biologists checked 8,518 hunter bags and examined 10,953 waterfowl.

The kill per man per day figure for 1957 was the same as that for 1956 and is the lowest recorded during the last five years. The duck kill per man per day (1.05) in the 1957 season appeared to be up slightly over the 1956 figure (.92). The goose kill showed a slight increase while the coot kill declined. The kind of ducks killed during 1957 is shown in Table VI.

The rice field shooting in Southwest Louisiana was poor during the past season. North Louisiana also had poor shooting despite high water levels and many flooded bottomlands. The state mallard population remained low and the kill of mallards (percent of total) was the lowest in the last five years.

On Catahoula Lake, which had good opening day success, early high waters resulted in a subsequent very low waterfowl population and a virtual cessation of hunting after the second weekend of the season. The Atchafalya River area had few ducks and the success of the small number of hunters using the area was very low. The southeast Louisiana area reported a low duck kill per man per day during the first six weeks of the season. Waterfowl numbers at Pass a' Loutre were less than in previous years, and the hunter kill was also reduced.



Two wood duck eggs in wood duck box on Chatham lake. Note how the hen has lined the box with down.

Charles "Chili" Baur, Biological Aid, checking wood duck boxes on Chatham Lake in Jackson parish. Boxes have been established in the area for biological studies.

The above factors should have contributed to a reduced kill in 1957. Indications are, however, that these losses may have been outweighed by other factors.

On Catahoula Lake and the Atchafalaya River area the early cessation of hunting and termination of bag checks resulted in a higher computed kill per man per day than would be expected over a season long check. In southwest Louisiana the rice field area is sampled but little by the present check stations. The marsh areas had good success and the current figures probably represent the southwest area as better than it really was—rice fields included. Although the percent of mallards checked was down in southwest Louisiana, the unusual increase in the kill of blue winged teal helped maintain a high success rate for the area. The marshes of this area were greatly affected by hurricane Audrey in June and aerial inventories indicated the fall distribution and composition of the waterfowl flock was much altered from that of previous years.

The southeast Louisiana area reported a much reduced kill of mallards and gadwalls this past season, but these early shortages were apparently made up during the last month of the season by a much increased kill of scaup. Hunter success in this area during the last month of the season was the highest in the state as a result of the high scaup kill.

In most areas of the state it was not possible to bring home a limit of mallards and pintails or other "big ducks". Although the composition of the bag may not have been entirely satisfactory to the hunter the state kill figure was maintained by the harvest of less desired species. It is believed that part of the dissatisfaction with the 1957 season resulted from the shortage of preferred species in the bag.

Waterfowl Banding Operations

Louisiana trapping operations were conducted during the fall and winter of both 1956 and 1957 in Louisiana. Between

TABLE I

Louisiana Waterfowl Inventory Data
September 1956 - May 1957

Waterfowl	Sept. 3-4	Sept. 17-19	Oct. 1-3	Oct. 15-17	Nov. 1	Nov. 15	Dec. 1	Jan. 8	Mar. 5	Mar. 21	Apr. 17-18	May 7-8
Pintail	12,000	27,000	25,000	93,000	282,000	459,000	640,000	466,000	26,000	4,500	Tr.	
Mallard				Tr.	2,000	318,000	598,000	718,000	91,000	6,500	Tr.	
Balpate				46,000	68,000	71,000	69,000	42,000	63,000	67,000	16,000	Tr.
Shoveller	Tr.	3,000	3,000	110,000	30,000	62,000	60,000	56,000	90,000	192,000	12,500	1,000
Gadwall				1,000	71,000	261,000	365,000	300,000	258,000	180,000	18,000	Tr.
Blue Winged Teal	75,000	154,000	158,000	222,000	34,000	5,000	5,000	Tr.	48,000	322,000	165,000	24,000
Green Winged Teal		19,000	18,000	56,000	183,000	440,000	430,000	381,000	411,000	160,000	Tr.	
Black and Mottled Ducks	14,000	13,000	15,000	15,000	15,000	15,000	21,000	28,000	9,000	5,0000	3,500	4,300
Wood Duck	29,000	28,000	35,000	36,000	39,000	41,000	48,000	53,000	25,000	20,000	15,000	15,000
Ring Necked Ducks				1,000	Tr.	36,000	39,000	62,000	26,000	2,500		
Scaup					Tr.	120,000	238,000	212,000	1,008,000	44,000	1,000	
Canvasback						8,000	14,000	33,000	13,000	Tr.		
Redhead						2,000	5,000	7,000	5,000			
Ruddy Duck					Tr.	9,000	28,000	32,000	18,000		3,500	
Merganser								18,000	2,000	2,000	Tr.	
Total Ducks	130,000	244,000	254,000	481,000	724,000	1,847,000	2,560,000	2,408,000	2,093,000	988,500	234,500	44,300
Blue Snow Geese		Tr.	Tr.	17,000	368,200	400,700	400,000	400,000	138,000	14,600	Tr.	
Canada Geese				1,000	2,000	3,400	4,300	7,100	1,200	2,400		
White Fronted Geese			1,000	10,000	8,000	12,200	12,200	5,000	3,000			
Total Geese			1,000	28,000	378,200	416,300	416,500	412,100	142,200	17,000	Tr.	
Canada Geese			6,000	60,000	94,000	113,000	146,000	95,000	72,000	87,000	63,800	3,100

TABLE II

Louisiana Waterfowl Inventory Data
September 1957 - January 1958

Waterfowl	Sept. 6	Sept. 23-24	Oct. 4-7	Oct. 15-17	Oct. 28-30	Nov. 19-23	Dec. 9-10	Jan. 6-7
Pintail	1,000	35,000	71,000	96,000	129,000	180,000	284,000	305,000
Mallard					28,000	163,000	434,000	473,000
Balpate		Tr.		12,000	41,000	170,000	260,000	220,000
Shoveller		3,000	2,000	9,000	18,000	126,000	134,000	130,000
Gadwall					93,000	331,000	451,000	300,000
Blue Winged Teal	130,000	134,000	143,000	131,000	128,000	115,000	120,000	110,000
Green Winged Teal		3,000	5,000	20,000	95,000	356,000	550,000	411,000
Black and Mottled Ducks	13,000	13,000	13,000	13,000	15,000	18,000	21,000	26,000
Wood Duck	20,000	20,000	28,000	35,000	37,000	37,000	35,000	32,000
Ring Necked Ducks					5,000	21,000	17,000	20,000
Scaup					206,000	500,000	250,000	250,000
Canvasback					Tr.	2,500	10,000	10,000
Redhead					Tr.	1,000	5,000	5,000
Ruddy Duck					5,000	10,000	10,000	8,000
Merganser					1,000	4,000	9,000	15,000
Total Ducks	164,000	208,000	262,000	316,000	801,000	2,034,500	2,590,000	2,315,000
Blue Snow Geese			8,000	350,000	400,000	400,000	400,000	
Canada Geese				Tr.	1,500	1,500	2,500	10,500
White Fronted Geese				2,000	4,000	4,000	4,000	12,000
Total Geese				10,000	355,500	405,500	406,500	422,500
Coots	2,000	2,000	4,000	25,000	128,000	246,000	276,000	279,000

With each kill at Pass-A-Loutre, game biologists of the Wild Life and Fisheries Commission get a chance to check the birds killed. District Supervisor Kenneth Smith checks kill of hunter.

September 1956 and January 1957 a total of 1,547 ducks were trapped at three stations in Louisiana.

On Catahoula Lake eight weld wire traps were operated from November 1956 to January 1957. The wintering waterfowl population was the largest since the study began in 1949. Natural waterfowl food conditions were also excellent and the food was available virtually throughout the trapping period. It was very difficult to bait the ducks away from the natural stands of chufa and millet and only 190 ducks were banded during the season.

Trapping on Coulee Refuge was also difficult because of low water levels but banding success was much better. A total of 1,306 ducks were banded during the three month season on Coulee.

A new trapping station was installed at the Rockefeller refuge in 1956 but low water levels and the presence of many bait stealers made trapping very unprofitable. A total of only 51 ducks were banded on this area.

George Files banding waterfowl on the Coulee waterfowl area in Morehouse parish.

Louisiana Wild Life and Fisheries commission personnel constructing a large "walk-in" type waterfowl trap on the Coulee game management area.

The trapping effort in 1957 was almost a complete failure. Extremely high waters on both Catahoula and Coulee Refuges disrupted the banding program. The trapping effort on Catahoula Lake had to be terminated almost as soon as it began because of the rapid rise and continued high level of the water. No ducks were banded on the lake in 1957.

George Files and helper banding waterfowl on the Coulee waterfowl game management area in Morehouse parish.

On Coulee Refuge, the banding stations were operated despite the high water. Results were disappointing with only twenty-two mallards being banded during 1957. The damage resulting from hurricane Audrey forestalled any trapping on the Rockefeller area in 1957. A report is being

Banding waterfowl on the Coulee waterfowl area; placing band on Mallard drake.

TABLE III

Waterfowl Hunter Bag Checks

State of Louisiana

Nov. 1-25, 1956 - Dec. 7, 1956 - Jan. 13, 1957

	Statewide Totals	N. W. La.	N. E. La.	Central La.	S. W. La.	S. E. La.	(Not Ave. in State Totals) Pass a' Loutre
No. Bag Checks	7,659	834	4,284	876	656	1,009	1,270
No. Ducks Checked	7,064	1,237	3,104	1,026	928	769	2,482
Ave. Duck Kill/Man/Day	.92	1.48	.72	1.17	1.41	.76	1.95
No. Geese Checked	473	0	5	90	370	8	44
Ave. Goose Kill/Man/Day	.06	0	....	.10	.56	....	.03
No. Ducks and Geese Checked	7,537	1,237	3,109	1,116	1,298	777	2,526
Ave. Duck and Goose Kill/Man/Day	.98	1.48	.73	1.27	1.98	.77	1.98
No. Coots Checked	1,932	14	201	21	1	1,659	240
Ave. Coot Kill/Man/Day	.25	.02	.05	.02	....	1.68	.19
Total No. Ducks, Geese, and Coots Checked	9,469	1,251	3,310	1,137	1,299	2,472	2,766
Total Waterfowl Kill/Man/Day	1.23	1.50	.78	1.29	1.98	2.45	2.18

TABLE IV

Waterfowl Hunter Bag Checks

State of Louisiana

Nov. 1-25, 1956 - Dec. 7, 1956 - Jan. 13, 1957

Species	Statewide	N. W. La.	N. E. La.	Central La.	S. W. La.	S. E. La.	(Not Ave. in Statewide Totals) Pass a' Loutre
Mallard	44.7	43.9	74.9	48.1	32.6	23.8	7.0
Green-winged Teal	8.8	5.1	12.4	5.3	12.9	8.3	10.0
Gadwall	9.3	4.7	1.4	1.8	8.4	30.1	47.0
Scaup	2.0	....	1.5	1.8	1.3	5.6	....
Pintail	11.2	8.2	3.0	35.4	7.2	2.1	6.0
Ringneck	4.8	21.5	.9	.1	.6	.9	....
Blue-winged Teal	3.9	12.0	2.4	.9	2.6	1.7	3.0
Shoveller	4.1	1.0	1.1	1.6	16.1	.7	6.0
Balpate	5.5	....	1.1	4.3	9.2	12.7	17.0
Mottled	1.5	....	....	....	6.9	.5	....
Canvasback	1.9	.2	.4	....	.4	8.3	....
Wood duck	.7	2.6	.1	.1	.2	.7	....
Black duck	.5	....	.2	....	1.1	1.0	....
Redhead	.5	.2	.2	.7	.5	1.0	....
Mergansers	.5	.6	....	....	....	1.8	....
Ruddy	.2	....	.4	.1	....	.3	....
Blue Geese	80.3	....	100.0	95.0	76.0	100.0	....
Snow Geese	18.4	....	....	2.0	23.0	....	....
Canada Geese	.4	....	....	1.0	....	....	....
White-fronted Geese	.9	....	....	1.0	1.0	....	....

TABLE V

Waterfowl Hunter Bag Checks

State of Louisiana

Nov. 2, 1957 - Jan. 10, 1958

	State Wide Totals	N. W. La.	N. E. La.	Central La.	S. W. La.	S. E. La.	(Not Ave. in State Totals) Pass a' Loutre
No. Bag Checks	7,542	677	2,420	464	2,431	1,550	1,036
No. Ducks Checked	7,825	488	1,301	439	3,799	1,798	1,537
Ave. Duck Kill/Man/Day	1.05	.72	.54	.95	1.56	1.16	1.48
No. Geese Checked	925	0	1	0	835	89	34
Ave. Goose Kill/Man/Day	.12	....	....	....	.34	.06	.03
No. Ducks and Geese Checked	8,750	488	1,302	439	4,634	1,887	1,571
Ave. Duck and Goose Kill/Man/Day	....	.72	.54	.95	1.91	1.22	1.51
No. Coots Checked	548	12	60	6	25	445	84
Ave. Coot Kill/Man/Day	.07	.02	.02	.01	.01	.29	.08
Total No. Ducks, Geese, and Coots Checked	9,298	500	1,362	445	4,659	2,332	1,655
Total Waterfowl Kill/Man/Day	1.23	.74	.56	.96	1.92	1.51	1.59

TABLE VI

Waterfowl Hunter Bag Checks
State of Louisiana
Nov. 2, 1957 - Jan. 10, 1958
Composition of Kill in Percentages

Species	Statewide	N. W. La.	N. E. La.	Central La.	S. W. La.	S. E. La.	(Not Ave. in Statewide Totals) Pass a' Loutre
Balpate	3.3	....	.6	4.3	4.3	4.2	15.6
Black	.6	....	1.2	....	.4	.9	.1
Blue winged teal	15.4	.2	2.0	8.2	28.4	8.0	9.4
Canvasback	.6	....	.2	.4	.6	.9	.6
Gadwall	6.6	9.8	4.2	1.0	6.4	9.4	32.5
Green winged teal	5.7	3.1	4.2	9.8	7.6	3.3	12.0
Mallard	30.6	24.8	71.9	24.2	25.1	13.9	9.1
Merganser	1.4	....	.4	.2	.6	4.2	.2
Mottled Duck	1.0	....	....	....	.9	2.6	.6
Pintail	9.2	8.4	7.1	36.2	10.5	1.9	3.8
Redhead	.6	.6	.1	....	.4	1.5	.1
Ringneck	4.2	49.2	.4	2.7	.3	2.1	.7
Ruddy — Goldeneye Bufflehead	.3	....	....	.4	.3	.6	....
Scaup	15.0	....	1.8	11.2	6.8	44.2	12.5
Shoveller	3.8	....	1.5	.4	7.4	.9	2.7
Wood duck	1.5	3.9	4.4	1.0	....	1.4	.1
Blue Geese	90.4	....	....	....	90.4	92.1	97.0
Snow Geese	7.3	....	100.0	....	7.1	7.9	3.0
W. F. Geese	1.8	....	....	....	2.0	....	....
Canada	.5	....	....	....	.5	....	....

prepared on all the waterfowl banded in Louisiana from 1949 to 1956. Previous reports have presented part of this material.

During 1956 no Commission personnel were sent to Canada to assist in the mass banding project under way there. In 1957 however, in conjunction with the cooperative Canadian banding program, the Commission Waterfowl Biologist Morton Smith spent six weeks in Saskatchewan as a member of Drive Crew I. The objective of the program is to band ducks on the breeding grounds in an effort to determine the contribution of certain nesting units to the various flyways and to shed more light on the distribution and harvest of waterfowl.

The five men in Drive Crew I banded a total of 6,393 ducks in the Saskatchewan area. Approximately 27,000 waterfowl were banded in the Prairie Provinces of Canada by crews assigned to the cooperative program in 1957. It is by such worthwhile large scale joint undertakings that many of the questions concerning waterfowl will be finally resolved.

Louisiana Waterfowl Situation

The condition of Louisiana's waterfowl habitat and the requirements for a sound state program are much the same as that described in the 1954-55 Biennial Report. Our state contains about 6,000,000 acres used by wintering waterfowl. Nearly one half million acres of this total is in inviolate refuges. Of these half million acres, 240,000 acres are managed by the United States Fish and Wildlife Service, 180,000 by the Louisiana Wildlife and Fisheries Commission and 26,000 by the National Audubon Society.

The state is presently managing only four areas as public shooting grounds for duck hunters. These areas are Pass a' Loutre, the Bodcau area near Minden, and the Shiloh Creek and Bayou LaFourche areas near Monroe. The total area involved on the four areas is only a little over 70,000 acres. Lease arrangements under the Pittman-Robertson program are nearly complete on two additional waterfowl areas in the coastal marshes.

Management practices for waterfowl vary on the shooting grounds. At Pass a' Loutre management consists simply of a patrol of the area and a regulated harvest of the waterfowl. No program is underway there to limit the damages occasioned by the dredging operations necessary in oil and sulphur exploration and development. Information is needed on how to hasten the replacement of vegetation ravaged by a past high nutria population and how to prevent similar destruction in the future. Several previously fine waterfowl areas at Pass a' Loutre have been greatly reduced in value as a result of the above factors and more are certain to follow. An intensive waterfowl management program is needed at Pass a' Loutre at once. It is the only public shooting grounds on State owned land and as such, should be developed into a model for waterfowl management in the lower Mississippi River delta area.

The public shooting grounds in the Monroe area are being managed in accordance with a recommended water fluctuation plan. The water is drained from the areas in spring and summer to prevent drowning of the areas' timber and loss of waterfowl food and cover.

A considerable additional acreage of potential use to waterfowl is located in the several large impoundments built by the State. At present these areas are not being managed for waterfowl. Lake Bistineau, Black and Saline Lakes, Turkey Creek, Cheniere Brake, and Anacoco are all open to public waterfowl hunting but support only light duck populations. The only practical management on these impoundments requires a fluctuation of water levels and such a program has not been acceptable to some groups.

One major area in Louisiana still remains in its original and most productive form despite recurring threats to alter it in one manner or another. This is Catahoula Lake, a 21,000 acre waterfowl area in central Louisiana. The lake produces a vast quantity of waterfowl food in the form of chufa and millet, and in most years the wintering and transient duck population is tremendous. The entire area, with the exception of the central State refuge, is open to public hunting and is heavily utilized by hunters. The main objective here should be to keep this area in its present condition and resist unwise proposals to dam this lake or otherwise seriously alter its drainage pattern. Any stabilization of water levels on Catahoula Lake will result in the certain destruction of its great waterfowl food areas. It should be remembered that

Catahoula Lake is of importance to the whole Mississippi flyway and not just Louisiana.

Of the six million acres of waterfowl area in the State, about one million acres are open to the public hunter. Most of this million acres is of poor quality however and produces few ducks for the gunner. Only a little over one percent of the Louisiana waterfowl habitat is in public shooting grounds. This figure should be increased as soon as possible and a reasonable goal would be about 15 percent.

Duck hunting is big business in Louisiana and as much as ten million dollars may be spent on it annually here. The recreational and esthetic value of the resource must far exceed its monetary value.

Several avenues are open by which additional public shooting grounds may be provided. In other states lands are purchased and developed for waterfowl. In Louisiana, under our present mineral law, it is difficult to buy large tracts of land at a price the State can afford. Surface leases can be obtained however on many acres of coastal marshes in southern Louisiana. These areas are usually attractive to waterfowl and can be improved by proper management. State owned lands presently under lease to private hunting clubs should be converted to public use when the leases expire.

Northeast Louisiana possesses several additional bottomland areas suitable for waterfowl development. Fortunately, the Ouachita River system appears to be a migration route for many mallards and waterfowl developments in the area are generally rewarded with good duck populations.

Charles "Chili" Baur, Biological Aid, trapping and banding doves on the Selman Field banding area in Ouachita parish. Doves are banded for migration and biological studies which assist the biologist in recommending a sound management program.

The main opporutnities in northwest Louisiana seems to be in an improved management plan for fish and waterfowl on the large impoundments. The acreages involved are great (17,000 on Lake Bistineau alone) and successful management could provide large use areas for hunters. Other opportunities remain in northwest Louisiana for development of waterfowl areas similar to the Bodcau Game Management area.

In addition to acquisition and development of waterfowl lands, Louisiana must continue its program of cooperation with regional, national, and international agencies engaged in the work of maintaining and improving the continental waterfowl resource. The management of a migratory species such as waterfowl is extremely complex and requires the understanding and cooperation of all state, federal, and international agencies. Louisiana is presently assisting in this work through membership in the Mississippi Flyway Council and its work with Ducks Unlimited and the U. S. Fish and Wild Life Service. We can expect future requests for greater assistance in solving flyway and continental waterfowl problems and should be prepared to provide this assistance.

Finally, our greatest waterfowl need is for close planning with the various agencies engaged in drainage and flood control. In many cases slight changes in planning can often prove beneficial to waterfowl interests rather than destructive. In any program the overall effects of projects should be reviewed in order to determine their true worth. Emphasis should be on multiple use projects that benefit all rather than single purpose plans that frequently are destructive to wildlife interests.

Some progress has been made since the last Biennial Report. Research work is continuing and four additional waterfowl public shooting grounds have been completed. Catahoula Lake has been retained in its most productive form. The number of new areas secured for public hunting has been small however, and every year's delay makes acquisition more difficult in the face of our rapidly increasing population. It is necessary to act now on this phase of the program.

MOURNING DOVE SEGMENT

JOHN D. NEWSOM
Study Leader

During this biennium, the scope of the dove project has been reduced. The project has been limited to trapping and banding, call counts, random road counts and collection of hunter kill data. The reduction in scope of the project is a result of the compilation of all data which have been collected on the Southeastern cooperative dove study, in which Louisiana was active with nine other states, from 1949 through 1954. The data contained in the final report indicate that adequate basic management data have been obtained in order to formulate broad management policies for this important game bird. Therefore, the current project is concerned primarily with the collection of information necessary for annual management; with particular reference to annual population levels.

Some additional information is needed on annual mortality and origin of certain segments of the population and for this reason the banding program has been continued.

Trapping and Banding

During the period covered by this report, 8,738 doves have been banded and 3,682 repeat captures made. This brings the lifetime total banding effort on this project in Louisiana to approximately 25,000 doves. This effort has fur-

Doves in trap on the Selman Field banding area. Approximately 8,000 doves have been banded on this area.

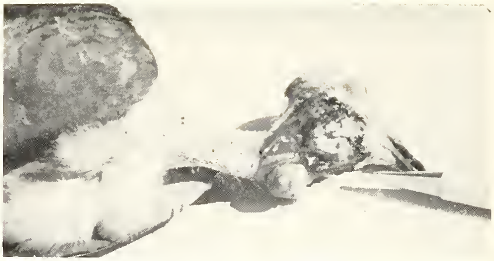
nished some very valuable information concerning the movements and migrations of resident and migratory doves. The major migration periods have been definitely established, as well as the pattern of distributional migration. This information has been very valuable in establishing statewide dove management policies. It is hoped that all banding data can be completely analyzed during the next biennium; this should provide a much better insight into the annual mortality picture which is badly needed.

Population and Productivity

Random road counts have been made during the past two years throughout the state—this technique is designed to furnish information primarily on annual populations after production, however the counts have been made throughout each year. Data gathered during this report period show no change during 1956, but a decrease in the overall population is indicated for 1957.

The "call count," as developed by the Cooperative South-

Dove nest containing three eggs.



Mourning dove with Trichomonas Gallinae (canker) infection killed in North Louisiana.

eastern dove study, is designed to give valid data on the annual breeding population of doves. This technique has been employed in Louisiana during the past two years on 14 permanent routes throughout the state. The data obtained have indicated a significant decrease in the breeding population of doves especially during 1957.

Although both inventory techniques have indicated decreases in the dove population during 1957, these decreases are not considered to be serious.

Dove with Trichomonas gallinae. Note how dove has starved from lack of food. Trichomonas blocks the trachea thus preventing food from passing through.

Dove Hunting Reactions

During the past two years, Louisiana has had a split season on doves with the first part opening in September and the second part closing as late as possible. This has proven to be a very satisfactory arrangement considering statewide hunting opportunities afforded. However, the needs for the coastal area cannot be met with this arrangement. It is the opinion of this writer that regulations should be established for the greatest number of sportsmen, and for this reason it seems obvious that the hunting season regulations, as established during the 1957 season, should become standard until such time as this state is allowed to operate under a zoning system as is presently used in some states. Under such a system of zoning, the needs of all the dove hunters in the state could be met.

TURKEY SEGMENT

John D. Newsom
Study Leader

The investigations of the status of released turkeys were conducted under the leadership of Joe Herring from January through August of 1956 and then by Raymond Moody through December. Some of the routine phases of the work were continued by the district supervisors in the areas concerned but the position of study leader was not filled and this study was not renewed after the close of the 1956-57 segment.

The results of the annual spring gobbling count on the four game management areas under observation during 1956 showed a total of 83 turkeys observed or heard during the counting period. In addition 13 birds were reported near but outside of the management areas. In comparison with the two previous years the turkey population was lower. This seems to be a continuing trend as the 1955 studies similarly showed a decrease from the 1954 counts and the 1957 spring gobbling count indicate 52 birds seen and heard on the areas and 16 reported near with a possible duplication of a few birds.

When Raymond Moddy took charge of the turkey study he initiated a preliminary investigation designed to determine the possibility and the feasibility of doing intensive turkey management work in the hope of increasing the native turkey population sufficiently to allow harvesting in the various sections of the state.

There are some suitable areas in the state where turkey do not exist at the present time and it was hoped a system could be worked out whereby the existing flocks of turkey might be increased in number sufficient to allow trapping and transplanting. Transplanting of pen raised turkeys has proven unsatisfactory in the state of Louisiana thus far.

The population of our native wild stock of turkey has been rather static over a good number of years. The more or less fixed population from year to year seems to exist in spite of the fact that a closed season has been in effect for the past 11 years with the exception of 1955, 1956 and 1957. A short turkey season was allowed in each of these years with a limit of one gobbler per hunter per season. A combined total of approximately 250 turkey were killed in the 3 seasons which were opened to legal turkey hunting.

It has been forcefully brought to our attention that the one most important limiting factor on the turkey population in the state of Louisiana is illegal hunting. Dogs have been and are still being used to hunt young turkey in the fall of the year. The hunter in this case is not particular about the sex of the bird he is taking and, in most instances, will kill the entire flock if possible.

In one instance where a flock of native wild turkey (20 odd head) were located in St. Helena Parish, Moody saw this flock of birds reduced to eight in number from October to November. Evidence has been shown to substantiate the fact that at least some of the birds fell victim to the human predator rather than to some wild animal or natural mortality.

Although it is possible to get consent of the land owners to do turkey management work on the areas, it would necessitate employing a man full time on the area to protect the birds, for without this protection the only accomplishment of intensive turkey management would be to furnish more meat for the illegal hunter.

Even considering that some turkey are taken incidental to squirrel by squirrel hunters, the fact remains that we have far more turkey hunters than had previously been supposed.

QUAIL SEGMENT

Robert E. Murry
Study Leader

As we approach the conclusion of the Quail Study as originally planned, we might do well to look around to see just what has been accomplished. A great deal of charted data on hunter success, young:old ratios, sex rations, food production under different environmental conditions, summer whistle counts, and covey size sight records are readily available for presentation here. This voluminous and often rather dry data, while of interest to the trained biologist, will be entirely omitted here since interpretation of these data is at best a rather uninteresting task.

A final technical report will be completed on the Quail Study after June 30, 1958.

This study was inaugurated in 1953 with one of the major objectives to test the cost and feasibility of applying predetermined management techniques to areas of the cutover Louisiana pinelands.

Early in the study it was realized that each type of development was restricted to a certain extent by the major land uses and their effect on the type and density of natural food and cover plants. Since our tests are being aimed at open range areas where the landowners are growing commercial pine timber results of the tests should be more or less applicable to the bulk of the lands in this type.

Do we know enough to jump into the field of large scale development work in an effort to provide public quail hunting? When attempting to answer this, several facts come to mind.

(1) The bulk of Louisiana's annual quail harvest is presently, and always has been, due to the accidental benefits quail have derived from some system of normal land use.

(2) Present land use is often more intensive than it formerly was and does not provide as much suitable habitat.

(3) Land use in the pine type is often compatible with moderately intense quail development.

(4) One of our most critical needs is the retention of hunting rights on the large blocks of industrially owned lands in the pine type.

(5) Firebreak strips, access routes, and utility right-of-ways can be developed to complement the quail producing ability of adjacent timbered lands.

(6) Any deliberate quail development work will result in rather costly birds when viewed in terms of cost per pound of meat.

(7) The best evidence available indicates that it costs Louisiana hunters between $4.00 and $5.00 per bird to *harvest* quail.

(8) Since most of the harvest expense is a fixed cost, extensive quail development, for which the hunter pays, could by providing *more* available birds, result in a *lower cost per bird* brought to bag.

(9) Additional protection above that provided by statewide season and bag limit regulations would appear to serve no useful function on a large scale quail development area, hence there would be no administrative costs once the areas were established.

Do we know enough to jump into the field of large scale development work in an effort to provide public quail hunting? The question still has not been answered "yes" or "no." Here is why: In addition to the above nine statements of fact which can be demonstrated, other factors must be considered. Foremost is the financial aspects of this situation.

If we are expecting to be able to produce quail for a few odd pennies each we had better stay away from all types of quail management and continue to expect the bulk of our harvest as accidental by-products of land use.

Despite an accumulation of evidence to the contrary, many people continue to believe that hunting pressure is the greatest mortality factor affecting the bobwhite quail. They usually reason that some added restrictions to further hinder the hunter are essential if quail hunting is to continue. There has never been, to this writer's knowledge, a planned study in Louisiana to determine the effect of hunting season kill on the quail population during the following season. Information gathered by scientific investigations in other portions of the bobwhite range reveal that the effect of legal hunting has often been highly overrated. General observations made on public hunting areas as well as hunter success data from controlled hunts indicate that failure to allow a harvest of a portion of a quail population annually is just as surely wasteful management as excessive harvest would be.

Inspection of young:old ratio data clearly indicate that about three-fourths of the quail in the state each hunting season were hatched the previous summer. This varies with the success of the summer nesting season that year and even varies considerably for different areas within the state the same year. It follows that if of each 100 quail 75 were *new* each year the population would continue to grow and grow unless something was happening to a great many of them. In fact if all mortality factors combined took less than 75% of them and the young:old ratio was 75.25 the following winter it would mean that there were more birds the second winter. However, when we protect a 40,000 acre tract of mostly fair quail range for 18 years and then find that we still have three-fourths of the population made up of birds that had hatched the previous summer we *know* that one of two things happened: (1) We had a whale of a lot of birds, or (2) Natural mortality without any help from the hunter had been taking a toll that balanced off the high production rate. That we *did not* have a whale of a lot of birds can be best emphasized by the fact that on this particular area 127 hunters could only bag 400 birds during a 15 day permit hunt.

Louisiana has a tremendous potential for quail, most of which can not be realized because of the economic demands made on the land for the production of agricultural crops and timber. Any quail development work considered must fit into a general plan of land management with little or no change to the productivity of the land for the primary crops.

Small farms generally produce a good many quail and can, by deliberate management, often produce many more. This phase of management should probably best be left to the landowner and his quail hunting friends who share the harvest as his invited guests. Large scale development work in this direction by a public agency does nothing to assure the average non-land-owning hunter an equitable share of the harvest unless he happens to be one of the people with permission to hunt on the property. Without actually providing physical help we still can do an important and useful job by providing technical assistance and encouragement to the small farmer and his friends who wish to make his place yield a few more coveys.

The large farm or plantation type operation usually is more difficult to manage for quail. Large field size and intensive land use are generally detrimental to accidental quail production, and deliberate management is relatively expensive. We do have a few examples within the state of highly successful quail development on high value farm land. Here again the hunting privilege rightly goes to the people who spent the money and effort required to create quail habitat.

In the pine type we have a relatively low accidental quail production per unit of area when considering this type as a whole. Despite this, localized actions of man often make some portions of the area in this type very productive for brief periods of time. Several factors known to affect quail ranges here are timber harvesting operations, fire, and soil scarification.

The effects of timber harvest and fire generally provide desirable conditions for quail for a few years. Soil scarification by plowing firebreaks or plowing for direct pine seedling makes an interspersion of types that are largely lost with the large cutting operation or the large burn.

Many owners of large blocks of land in the pine type have expressed an interest in quail development work for public hunting. If we are ever to expect them to save us a small percent of their acreage upon which we can provide better quail hunting for the public we need to take the necessary steps in that direction in the near future. It may prove to be a wise investment in public relations for the owner as well as providing continued hunting opportunity for a great many of Louisiana's quail hunters.

SQUIRREL SEGMENT

J. B. Kidd
Study Leader

The most important data collected on this study during the years 1956 and 1957 are presented in the following tabular forms. As can be seen from these tables, hunter bag checks in the field, breeding studies, trapping and tagging have been our most important jobs.

Hunter Bag Checks

Presented in Tables I and II are the results of the squirrel hunter bag checks for the two years concerned. It is noted that hunter success throughout the state for the 1957-58 season ran very close to hunter success of the previous year. Seven hundred and fifty-nine (759) hunters checked in the field killed 1,297 squirrels for an average kill per hunting effort of 1.7 squirrels. The previous year (1956-57) hunters averaged 1.6 squirrels bagged per hunting effort.

It should be pointed out that the state-wide average during the 57-58 season is computed from hunters that were checked throughout the state excluding the game management areas.

Eight of our game management areas were open to hunting again during the 1957-58 season (See Table II). The opening of these areas was again considered successful as 4,851 hunts on these areas resulted in the killing of 8,740 squirrels for an average kill per hunting effort of 1.8 squirrels. Hunter success on these areas ran very close to the state-wide success of 1.7 even though no hunting was allowed during the 1956-57 season.

It is believed that hunter success may have been better during the 1957-58 season had not the squirrels already resorted to ground feeding when the season opened on the eighteenth of October. This problem can be eliminated by opening the season on the first of October which will insure the still hunter a greater harvest of squirrels. Five years of research indicate that there is no biological reason why the squirrel season can not be opened on the first of October.

Breeding Studies

Data gathered on age, sex ratios and breeding are presented in Tables III and IV. It is well to note that spring born animals far exceed the summer born for both years concerned. This would indicate that the majority of our juveniles are born in the spring. Other data concerning age and sex ratios is clearly presented in the tables.

Presented in Table V is information collected on gray squirrel litters checked on the court house square in Shreveport. Since this is the first time squirrel litters have been handled to any extent, there were, no doubt, some errors made in determining the age of the young animals.

As best can be determined from the data, fourteen litters were considered as spring born animals as compared to nine that were born in the summer or fall. At approximately 10 weeks of age the young squirrels seem to be completely independent of the mother. There is some contradiction to the foregoing statement in the table, but as was mentioned before there were, no doubt, some errors made in determining the age of the infant animals.

The average litter size of the litters checked was 2.4 young.

Trapping and Tagging

In an effort to further study the effects of hunting pressure on the squirrel population, a concentrated trapping and tag-

TABLE III

Age and Sex Ratios and Breeding Conditions of Adult Females

(Fox Squirrels — No. Examined 1291)

Date		Male	Female	Females		Female Adults		Female Juveniles	
				Adult	Juvenile	Breeding	Non-Breeding	Spring Born	Late Summer or Fall Born
Oct. 1956	Per Cent	42.9	57.1	28.3	71.7	30.2	69.8	84.7	15.3
	No. Examined	554	737	209	528	10 preg. 53 suck.	146	447	81
(Gray Squirrels — No. Examined 314)									
Oct. 1956	Per Cent	50.8	49.2	37.1	62.9	28.1	71.9	73.2	26.8
	No. Examined	160	154	57	97	1 preg. 15 suck.	41	71	26

TABLE IV

Age and Sex Ratios and Breeding Conditions of Adult Females

(Fox Squirrels — No. Examined 1291)

Date		Male	Female	Females		Female Adults		Female Juveniles	
				Adult	Juvenile	Breeding	Non-Breeding	Spring Born	Late Summer or Fall Born
Oct. 1957	Per Cent	51.0	49.0	53.0	47.0	17.7	82.3	88.1	11.9
	No. Examined	1867	1808	852	956	10 preg. 140 suck.	702	842	114
(Gray Squirrels — No. Examined 1788)									
Oct. 1957	Per Cent	52.9	47.1	43.8	56.2	16.5	83.5	54.5	45.5
	No. Examined	946	842	369	473	1 preg. 60 suck.	308	258	215

TABLE V

Gray Squirrel Litters Checked On Court House Square in Shreveport

Box No.	Date Litter First Checked	Approximate Time If Determined	No. In Litter	Last Date Litter Checked	Remarks
851	Feb. 28, 1957	7-18 days	4	Apr. 2, 1957	Full grown when last checked
1	Feb. 28, 1957	7-18 days	2	Mar. 6, 1957	Young absent
172	Mar. 5, 1957	1- 7 days	1	Apr. 2, 1957	Young absent
2	Mar. 6, 1957	½ grown	2	Apr. 2, 1957	Young absent
270	Mar. 6, 1957	2- 3 days	3	Apr. 2, 1957	Young absent
115	Apr. 2, 1957	14 days	2	Apr. 10, 1957	Young absent
4	Feb. 28, 1957	18-20 days	4	Mar. 12, 1957	Young leaving box & playing in tree
847	Mar. 12, 1957	½ grown	1	Mar. 19, 1957	Young grown
109	Mar. 6, 1957	1/3 grown	2	Apr. 2, 1957	Young absent
905	Mar. 6, 1957	1- 2 days	2	Apr. 2, 1957	Young absent
249	Apr. 10, 1957	1- 7 days	2	May 15, 1957	One young adult, left, other absent
791	Apr. 2, 1957	1-14 days	3	May 20, 1957	Young adults present
905	May 15, 1957	1-14 days	2	May 20, 1957	Young present
175	July 2, 1957	Fully furred	2	Litter not checked again	
115	July 2, 1957	14 days	2	Sept. 4, 1957	When last checked one animal still in box too large to handle
270	July 2, 1957	14 days	3	Aug. 29, 1957	Young on top of box—too large to handle
851	July 11, 1957	1- 3 days	1	Aug. 1, 1957	Young absent
249	July 11, 1957	1- 3 days	2	Sept. 4, 1957	When last checked, still in box but too large to handle
847	July 17, 1957	1- 3 days	3	Sept. 4, 1957	When last checked, still in box but too large to handle
851	Aug. 8, 1957	21 days	3	Aug. 21, 1957	Fully furred
818	Aug. 21, 1957	28 days	3	Sept. 4, 1957	Young too large to handle
109	Aug. 29, 1957	1- 2 days	2	Oct. 23, 1957	Young too large to handle
175	Sept. 4, 1957	3- 7 days	3	Oct. 23, 1957	Young too large to handle

TABLE I

SQUIRREL HUNTER BAG CHECKS — 1956-57

Parish	No. Hunters Checked	— No. of Squirrels Killed — Fox	Gray	Unknown	Average Kill Per Hunting Report	Estimated Crippling Loss
Beauregard	19	26	7	0	1.7	
Allen	64	114	159	0	4.2	
Bossier	624	251	262	0	0.8	
Concordia	250	268	111	545	3.7	
Catahoula	1	1	0	0	1.0	
East Carroll	6	7	0	3	1.7	
Grant-Rapides Line	265	522	29	0	2.1	
LaSalle	21	15	1	0	0.9	
Morehouse	26	24	4	0	1.1	
Ouachita	19	10	15	0	1.3	
Pointe Coupee	155	77	158	0	1.6	
Rapides	327	387	65	0	1.4	
Richland	12	11	1	0	1.0	
Sabine	6	4	5	0	1.5	
St. Landry	67	93	17	0	1.6	
Union	63	29	57	0	1.4	
Winn-Grant Line	147	122	145	0	1.8	
TOTALS	2,164	2,083	1,045	548	1.6	5%

TABLE II

SQUIRREL HUNTER BAG CHECKS — 1957-58

Parish	No. Hunters Checked	— No. of Squirrels Killed — Fox	Gray	Unknown*	Average Kill Per Hunting Report	Estimated Crippling Loss
Beauregard	40	39	8		1.1	
Bossier	99	63	43		1.1	
Catahoula G.M.A.*	748	251	1110		1.8	
Caldwell G.M.A.*	182	203	0		1.1	
Concordia	273	352	99		1.7	
East Carroll	2	1	2		1.5	
Evangeline G.M.A.*	200	204	24		1.1	
Grant-Rapides Line	104	251	11		2.5	
Jackson-Bienville G.M.A.*	1920	860	2973		1.9	
Grant-Rapides G.M.A.*	1410	2350	90		1.7	
Lincoln	16	19	10		1.8	
Livingston	42	9	56	3	1.6	
Morehouse	28	24	4		1.0	
Ouachita	34	15	34		1.1	
Pointe Coupee	74	10	149		2.2	
Richland	27	68	6		2.7	
Sabine No. 1 G.M.A.*	112	54	97		1.4	
Sabine No. 2 G.M.A.*	77	25	89		1.5	
Union	14	5	9		1.0	
Union Parish G.M.A.	202	87	323		2.0	
Webster	2	2	3		2.5	
West Carroll	4	5			1.3	
TOTALS	5,610	4,897	5,140		1.7	10%

Hunters checked *inside* game management areas	4,851
Number of squirrels killed	8,740
Average kill per hunting effort	1.8

Hunters checked *outside* game management areas	759
Number of squirrels killed	1,297
Average kill per hunting effort	1.7

* Half day hunting only.

ging effort was conducted on the Grant-Rapides game management area four months prior to the 1957-58 hunting season. This operation resulted in the capture and tagging of 97 animals before the season opened.

During a 14 day hunting season in which 2440 squirrels were killed and 1410 hunts were made, fifteen tagged animals were killed and returned by hunters. This means that although 1410 hunts were made, only slightly more than 15 per cent of the tagged animals turned up in the hunters bags. Does this not indicate then that the hunter only takes a small percentage of the squirrel population each year?

RABBIT INVESTIGATION

Jack Sims
Study Leader

During the past two years information has been collected which will be of value in setting rabbit hunting regulations and seasons.

Much of the information has been collected on a Statewide basis, and credit should be given to the hunters as well as the employees of the Pittman-Robertson Section of the Louisiana Wild Life and Fisheries Commission.

As of June 1, 1956, the reproduction study phase of the investigation was terminated. Up to this time eighty six (86) adult female rabbits were examined to determine their breeding condition. Of the number examined, forty-four (44) were cottontails and forty-two (42) were swamp rabbits.

Using the information available in Table I and Table II, we can draw certain conclusions as to the breeding season. In regard to the cottontail, it appears that the major breeding season is covered by the period from February through August. This conclusion is drawn from the information contained in Table I.

The breeding season for the swamp rabbit seems to be about the same as that of the cottontail. The major breeding season for the swamp rabbit is covered by the period from February through August. This conclusion is drawn from the information contained in Table II.

In determining the breeding seasons for both species, at least fifty percent of the females examined had to be in breeding condition during the particular months listed as the breeding season. These dates may vary slightly due to the fact that information collected during certain months may not be adequate. It should also be brought out that females have been found in breeding condition during all the months of the year. It is interesting to note that a fairly high percentage of both species examined during December, 1955, were in breeding condition. However, the percentages of breeding females in January was again very low, but both species were back up to at least fifty percent in February. This is probably due to a weather factor.

One phase of the investigation was to try to determine the normal movement of rabbits that were not subjected to hunting pressure. In order to do this, four twenty-acre study units on a 880 acre study area were trapped. All rabbits caught were tagged and released at the trap site. The distance between trapping units varied from a maximum of 2,640 feet to a minimum of 1,320 feet.

Trapping was begun on December 28, 1955 and carried on until March 21, 1957 with the exception of the hot summer months. During this period a total of sixty-two (62) rabbits were tagged and released. Counting the retraps, a total of 240 rabbits were trapped and released. This gives a retrap figure of approximately four (4) for each individual trapped.

Of the total number of rabbits trapped, there was not one instance of an individual being retrapped on a unit other than the one where it was originally tagged. There were a number of instances of individuals being trapped at sites other than the one at which they were originally tagged. From this we can assume the normal range for a cottontail is less than 1,320 feet which is the shortest distance between any two units.

Certain of the units were planted to a winter forage crop in order to attract rabbits from the unplanted units. There were no instances of rabbits moving from one unit to the other because of the winter forage made available.

Another phase of the investigation was to try to determine what effect, if any, grazing by stock has on a rabbit population. To determine this, two adjacent forty-acre plots were selected. One area was to be grazed and stock was to be excluded from the other area. These two areas are located in Morehouse Parish ard are of mixed bottomland hardwood type.

Twenty five (25) box type traps were set on each area beginning in March 1957. During the months of March and April, 950 trapping efforts were made, and only two rabbits were tagged. The low trapping success was believed to be caused by the early "greening up" of natural foods. A number of baits were tried, but the success was not increased. Trapping was again attempted in November and December, 1957, but due to the continued high water the operation was not successful. This phase of the study will continue through the remainder of the winter of 1957-58.

In an attempt to determine the effect of hunting pressure on populations, two types of check areas were to be set up. Two eighty-acre units were to be set up and hunted during the season with dogs. The same areas were to be hunted again the same number of times the following years to see if any decrease was noticed from the previous years. However, due to the unavailability of dogs, this segment has not been started.

Two forty-acre areas have been set up to be hunted at night during the entire year to see if the population on the area could be destroyed. These areas are being hunted, but not enough information has been collected to determine what effect, if any, this would have on the population.

In order to determine the rabbit hunters success, an attempt was made to conduct as many hunter's bag checks as possible. Due to the fact that rabbit hunters do not tend to concentrate on certain areas, it was very difficult to collect a large number of checks.

During the 1956-57 season, only twenty five (25) parties were checked. These twenty five (25) parties were composed of sixty-eight (68) hunters. All of the 105 rabbits bagged by the 68 hunters checked were examined and recorded. The information obtained during the 1956-57 season can be found in Table III.

TABLE I. Breeding Condition of Female Cottontails

	Number	Breeding		Non-Breeding	
Month	Examined	Number	Percent	Number	Percent
June, 1955.	1	1	100	0	
July	2	2	100	0	
August	2	2	100	0	
September	1	0		1	100
October	0	0		0	
November	2	0		2	100
December	6	3	50	3	50
January, 1956	6	0		6	100
February	7	4	57	3	43
March	7	6	85	1	15
April	2	2	100		
May	8	8	100		

TABLE II. Breeding Condition of Female Swamp Rabbits

	Number	Breeding		Non-Breeding	
Month	Examined	Number	Percent	Number	Percent
June, 1955	3	3	100	0	0
July	2	2	100	0	0
August	1	1	100	0	0
September	0	0	0	0	0
October	4	0	0	4	100
November	4	0	0	4	100
December	6	2	33	4	67
January, 1956	12	1	8	11	92
February	2	1	50	1	50
March	2	2	100	0	0
April	0	0	0	0	0
May	6	6	100	0	0

In order to obtain more information during the 1957-58 season, questionaires were sent to eighty three (83) hunters asking if they would be willing to keep an accurate record of their kill during the season. Of the number contacted, fifty three (53) agreed to keep the information desired. The kill forms were mailed out prior to the season, but the information obtained will not be included in the report due to the period of coverage by this report.

To keep a check on the population trend of rabbits, random road counts are made over the entire State every month of the year. This information in no way gives any indication of the total State rabbit population, but can be used to determine if the population is above or below the same period during the previous year.

During the year 1956 counts on rabbits seen while driving were kept during 123,192 miles of travel. During the year 1957 counts were kept on 145,246 miles of travel. These rabbits recorded were those seen, both dead and alive, while driving during daylight hours only. The information used in preparing this total can be found in Table IV and Table V later in this report.

We can also assume that the population during the early months of 1957 was lower than the same period during 1956. However, by the time the hunting season opened in 1957 the population was about the same as during 1956. During December 1957 the counts were considerably higher than in 1956. This is an indication of a good breeding season.

Considering all factors, we can assume that going into the 1957-58 rabbit season, the hunter should have a good season, barring any extreme weather conditions to curtail his hunting efforts.

TABLE III. Hunter's Success

Type of Hunt	Hunting Efforts	Cottontails Adults Male	Cottontails Adults Female	Cottontails Juvenile Male	Cottontails Juvenile Female	Swamp Rabbits Adults Male	Swamp Rabbits Adults Female	Swamp Rabbits Juvenile Male	Swamp Rabbits Juvenile Female	Hunter's Success
Dog	3					2	1	2	2	2.33
Dog	4					2	2		3	1.75
Dog	2						1	1		1.00
Dog	3	2	3	1		1				2.33
Dog	6					3		1		.66
Dog	3					2	1	1		1.33
Dog	2					1	1	1	2	2.50
Dog	4					2		1	2	1.25
Dog	2	0	0	0	0	0	0	0	0	0.00
Dog	2						1			.50
Dog	3					1	1	2	3	2.33
Dog	3					1			1	.66
Dog	2	2								1.00
Dog	2	1				2	2			2.50
Dog	4			1		2		1		1.00
Dog	3					6	3			3.00
Dog	3					5	5			3.33
Dog	2					1	1			1.00
Dog	3					2	1		1	1.33
Dog	2					3				1.50
Dog	3					2	3			1.66
Dog	2					2	2			2.00
Dog	1	1				1				2.00
Dog	3					3	1			1.33
Other	1	0	0	0	0	0	0	0	0	0.00
TOTALS	68	6	3	2	0	44	26	10	14	1.53

TABLE IV. Random Road Counts — 1956

Month	No. Miles Traveled	Rabbits Seen Per 100 Miles of Travel
January	9,143	1.69
February	5,270	2.81
March	17,447	1.35
April	17.824	.98
May	9,884	.73
June	9,269	.69
July	11,460	.50
August	11,787	.34
September	8,417	.56
October	7,546	1.03
November	8,030	1.03
December	10,115	1.32
	123,192	

TABLE V. Random Road Counts — 1957

Month	No. Miles Traveled	Rabbits Seen Per 100 Miles of Travel
January	11,763	1.33
February	11,473	2.06
March	16,081	.93
April	12,908	.67
May	16,491	.90
June	13,780	.92
July	14,507	.91
August	10,750	.47
September	13,240	.37
October	14,690	.57
November	5,095	.96
December	4,468	2.22
	145,246	

OAK MAST AND T. S. I. SEGMENT

Jack Collins
Study Leader

This project to determine mast production of oaks and their values to wildlife was initiated in 1950. From 1950 to 1954 the studies were conducted entirely on the Kisatchie National Forest in the Red Dirt and Catahoula Game Management Areas. In 1954 the project was enlarged to cover representative samples from the entire state.

In conjunction with the oak mast study a timber stand improvement (T.S.I.) project with relationships to its effects on wildlife was begun in 1954. Study areas are located on the Catahoula Game Management Area.

The needs for and significance of this research were brought out in the last biennial, but it will be elaborated on in the paragraphs below.

Oaks are found in the four general tree regions of Louisiana. Whether they grow in the shortleaf - oak - hickory, the longleaf pine, the bottomland hardwood, or the upland harwood forest regions, the nut crop is used by wildlife.

The upland oaks, consisting mainly of southern red, post, blackjack, and sandjack oak, and other currently unmerchantable hardwoods pose a difficult problem to the forestry industry managing lands for pine production. According to the U. S. Forest Service, Forest Survey Release No. 75, "More than six million acres of Louisiana pine sites need timber stand improvement work to eliminate undesirable hardwoods".

Numerous landowners interested in managing their lands for pine production have conducted timber stand improvement operations and are continuing to remove hardwoods from their lands.

It is apparent that hardwood control, particularly on the oaks, will continue at an intensified rate for several years to come. Sportsmen and professional people alike have become concerned over the effect of this movement on game habitat.

At the same time many land owners and supervisors of pine land management are interested in placing some emphasis on game habitat in their T. S. I. operations. These people are asking for information regarding the number of hardwoods to leave in their stands. It is not always easy to answer these questions. In fact many cannot be conclusively answered presently.

Both phases of the project are a part of the program of the Pittman-Robertson section of the Louisiana Wild Life and Fisheries Commission.

The methods of operation for both phases of this project were discussed in the preceding biennial report.

Data in this report covers the period of 1955 and 1956.

The discussion presented below will be in the following order: (1) Upland oaks on Red Dirt; (2) Bottomland oaks on Red Dirt and Catahoula Game Management Areas (3) Statewide oak mast picture, and (4) The timber stand improvement study with relations to its effects on wildlife.

Production of acorns on the three upland oak species or "scrub oaks", blackjack oak, sandjack or bluejack, and post oaks was best on the blackjacks in 1955. Average production was 638 acorns (1.71 pounds) per tree. Sandjacks were second in yields in 1955 with about half as many acorns per tree as the blackjacks. Post oaks were insignificant in the overall picture in 1955.

This was just the reverse of the picture in 1956 when post oaks far outstripped the other two species of scrub oaks. The total production for seven selected post oaks was 5,051 acorns. This was an average of 722 acorns or 1.39 pounds per tree. Sandjack oaks were second in yields having an average of only 9 acorns. Blackjacks showed an average of 3 acorns per tree. See Table I.

On Red Dirt the percent of sound acorns ran as follows for the three scrub oaks: 56 and 100; 58 and 100; 51 and 81 for blackjacks, sandjacks, and post oaks in 1955 and 1956 respectively.

TABLE I

Oak Mast Production on 31 Sandjack, 17 Blackjack, and 7 Post Oak Trees on the Red Dirt Game Management Area in 1955 and 1956

	1955		1956	
	No. Acorns		No. Acorns	
Species	Total	Average	Total	Average
Sandjack	10,083	325	270	9
Blackjack	10,855	638	52	3
Post Oak	510	73	5,051	722

Five species of bottomland oaks under study on Red Dirt and Catahoula Game Management Areas are water oak, white oak, southern red oak, cow oak, and willow oak. Table II readily illustrates the differences in mast yields.

TABLE II

Oak Mast Production on 17 Water Oaks, 11 White Oaks, 8 Southern Red Oaks, 5 Cow Oaks, and 28 Williow Oaks on the Red Dirt and *Catahoula Game Management Areas in 1955 and 1956

	1955		1956	
	No. Acorns		No. Acorns	
Species	Total	Average	Total	Average
Water Oak	23,536	1,384	776	46
White Oak	113	10	10,160	924
Southern Red Oak	12,085	1,510	0	0
Cow Oak	0	0	5,080	1,016
Willow Oak	7,732	297	....	....

* All trees referred to are on Red Dirt except the Willow Oaks.

Curtis L. Hollis, Game Management area supervisor for the Union parish Game Management area is checking acorn traps used in mast and T.S.I. studies.

Although usually a moderate producer the southern red oaks showed top results in 1955. There was an average of 1,510 acorns or 1.14 pounds per tree. Water Oak was second in production with an average of 1,384 acorns (1,789 pounds) per tree. Willow oaks were third in mast production showing yields of only 297 acorns per tree. For the other two species of bottomland oaks results were negligible in 1955. Cow oaks and Post Oaks yielded 0 and 10 acorns per tree, respectively.

Trees in the white oak category were the best producers in 1956; whereas, in 1955, trees in the red oak group bore the most acorns. It should be pointed out here that no individual tree of any species will bear a good crop of acorns every year due to the nature of trees in general. Climatic factors often affect yields.

In 1956, cow oaks and white oaks produced an average of 1,016 (7.21 pounds) and 924 (3.95 pounds) acorns, respectively. According to Table II the various red oaks under study had negligible results in 1956.

Percent sound acorns on the bottomland oaks in 1955 and 1956 were as follows: water oak—50, 54, white oak—100, 87, southern red oak—62, 0, cow oak—0, 88, willow oak—29, respectively.

On the statewide level Table III is indicative of acorn production in the state for the three year period, 1954, 1955 and 1956. A brief summary follows below:

Mast production of oaks in the white oak classification over the three year period was best in 1956. Trees in the white oak class being studied are the overcup oaks, white oaks, cow oaks, and post oaks.

Comparing production of the various red oak species, which include willow oaks, water oaks, blackjack oaks, southern red oaks, nuttall oaks, obtusa, and sandjack oaks, over the three year period shows yields were best in 1955 for all

TABLE III

Statewide Acorn Mast Production of Oaks Being Studied in Louisiana — 1954-1955-1956

	No. Trees Under Study			Ave. Production			Ave. Weight		
Species	1954	1955	1956	1954	1955	1956	1954	1955	1956
Overcup Oak	36	53	53	4,099	878	7,608	....	6.20	26.26
Willow Oak	38	50	28	2,571	4,535	1,850	....	16.63	3.11
Water Oak	37	58	58	2,158	23,021	1,045	....	56.12	1.64
White Oak	30	39	39	1,512	61	2,354	....	0.62	9.78
Blackjack Oak	17	17	17	1,589	638	300	....	1.71	0.01
Southern Red Oak	26	26	25	1,238	1,825	0	....	2.35	0
Nuttall Oak	18	36	36	979	2,951	1,125	....	18.12	4.37
Post Oak	25	25	24	928	24	1,598	....	0.04	2.97
Obtusa Oak	9	....	4	....	....	1,687	....	....	....
Sandjack Oak	31	31	31	179	325	9	....	0.51	....
Cow Oak	12	13	13	263	224	638		1.77	5.61

species except blackjack oak. It yielded best in 1954. The large decline in production by trees in the white oak class in 1955 and trees in the red oak class in 1956 was due primarily to the late March freeze in 1955. Trees in the white oak category require only one growing season for their acorns to reach maturity; the red oaks require two growing seasons.

For all species healthy and vigorous growing tees with dominant widespread crowns were the best producers. Age was of less significance in affecting production.

The Timber Stand Improvement Study

Purposes and objectives of the study were previously brought out, but a short description of the methods used follows.

The area where intensive studies are being conducted is located about 30 miles north of Alexandria, Louisiana on the Catahoula Game Management Area.

Four types of T. S. I. are under study. These include the following: (1) U. S. Forest Service method, (2) Compromise cut recognizing minimum wildlife rrquirements, (3) Clear-cut (all hardwood removed), and (4) Control (Uncut). Plots treated for study are 160 acres in size. There are two of each type T. S. I. treatment.

From the types outlined above some of the effects on oak mast, squirrels and deer will be determined.

Although preliminary stages of this project were initiated in 1954 little data was gathered before the fall of 1956. Hence, most information below will pertain to the period from September, 1956 to July, 1957.

Concerning the oak mast phase of the research, southern red oaks and post oaks were selected for study because most of the oaks on the area were comprised of these two species. Southern red oaks bore no acorns in 1956. The post oaks on the plots showed some production, but it was very poor. Table IV shows that those acorns reaching maturity on the compromise cut method were about twice as large as those on the other type treatments. All of the trees on the Compromise Cut areas were released from competition. It should be emphasized that no definite conclusions can be drawn from one year of study. Continued research on this matter will be necessary.

Seventy-two percent of the 110 acorns were sound.

The deer browse survey using the Aldous method revealed that both red and white oak sprouts proved to be an important source of deer food the first year after T. S. I. treatments. However, the second year sprout growth showed much less usage by deer. In 1957 the red oak sprouts were present on about twice as many plots as in 1956 on all the treated areas. The white oak sprouts increased the second year but not nearly so much as those of red oaks.

Twenty-seven species of plants were listed for study in 1957 on each of the four type treatments. All of the species were present on the U. S. Forest Service and Control type treatments. Twenty of the species were present on the Compromise Cut; twenty-one were present on the Intensive or Clearcut treatment. More species occurred in only small quantities on the Compromise and Clearcut treatments than on the other two types.

As noted there were less browse species available for deer on two of the types treated. The exact cause of disappearance or whether the plants will recover will not be determined until further studies are conducted.

A squirrel census is conducted on each of the 8 areas once each month year round. This is done to determine, if possible, the effects of various T. S. I. treatments on squirrel populations. See Table V.

Although no final conclusions should be drawn from Table V it is well to point out that those areas having less mast bearing trees showed a smaller squirrel population. The census is only an index to populations.

The years, 1956 and 1957, had poor acorn crops. Had more acorns been produced the squirrel population indexes might have been different.

To obtain a better understanding of oak mast and T. S. I. as they affect game animals such as deer, squirrels, and others this project should be continued for a number of years.

DISTRICT I

John L. Haygood

Supervisor

BODCAU GAME MANAGEMENT AREA

Kinsey Martin

Area Supervisor

This wild life management area embraces the Bodcau Flood Control Project owned by the U. S. Government. The wildlife program is a co-operative project between the Louisiana Wild Life and Fisheries Commission and the U. S. Army Corps of Engineers. This area is located in Bossier and Webster

John L. Haygood, Supervisor, District I, placing sand bags on the Bodcau Public Shooting area levee.

TABLE IV

Calculated Number and Weight of Acorns Produced by 10 Post Oaks On Each Type T. S. I. Treatment On the Catahoula Game Management Area in 1956

Compromise Cut		U. S. Forest Service		Control (Uncut)	
Average No. Acorns	Pounds of Acorns	Average No. Acorns	Pounds of Acorns	Average No. Acorns	Pounds of Acorns
50	0.10	114	0.11	264	0.22

TABLE V

Average Number of Squirrels Observed Per Month On Each Type T. S. I. Treatment from October, 1956 to December, 1957*

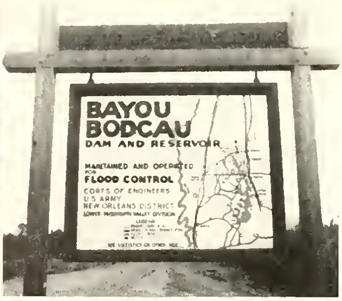
PLOT TREATMENTS

	Control	U. S. Forest Service	Compromise Cut	Clearcut
No. Squirrels	2.45	2.54	1.0	0.09

* Based on combined data obtained from two 20-acre plots treated in like manner.

Flooded oak flats.

Construction of Louisiana Wild Life and Fisheries dam on Bodcau.



Sign on Army engineers' dam on Bodcau.

Construction of access roads on Bodcau.

Parishes along Bayou Bodcau from Bellevue to the Arkansas State line.

The purpose of this wildlife area is to provide public outdoor recreation in the form of hunting, fishing, and camping. It is the object of the Louisiana Wild Life and Fisheries Commission in co-operation with the U. S. Army Corps of Engineers to develop the wildlife resources to their maximum for public use. This is the first of this type development for Northwest Louisiana sportsmen. The Bodcau area is unique in that it will eventually provide almost every type hunting available in Louisiana on this one area.

Winter wheat for deer.

Development was started in the summer of 1956 when the Fish and Game Division moved a bulldozer and dragline into Bodcau Bottom. At this time a dam was built to impound 1,200 acres of shallow water over pin oak flats. This green timber reservoir is managed to attract waterfowl during the fall and winter. The water is released in late winter thus allowing the reservoir to dry up during summer months and keep the oak timber alive. At the present two main access roads are being built to provide a way for hunters to get in and out. In July 1957, the Federal Aid Section of the Fish and Game Division started participating in this program. Concrete culverts were bought for the roads. A tractor and farming equipment was bought, dove waterfowl food plots were planted. Development work is planned that will take about five years, such as, more waterfowl reservoirs, boatroads, food plots, and habitat improvements. Deer are increasing, squirrel hunting is good and should get better as the oak timber matures. This area will provide a place to hunt for future years and generations.

JACKSON-BIENVILLE GAME MANAGEMENT AREA

Floyd Sizemore
Area Supervisor

The Jackson-Bienville Game Management Area is located in the eastern part of Bienville Parish and the western part of Jackson Parish; just south of Ruston, and north of Jonesboro. This is a heavily wooded area, excellent deer and squirrel range, covering about 22,000 acres. The topography is gentle rolling; three creeks drain through this area, Dugdemona, Madden and Redwine. Along these creek bottoms is some of the best squirrel hunting in North Louisiana. The hills are covered in mixed pine and hardwood mostly in the sapling and pole stage, which makes for very thick woods and excellent deer range.

The purpose in establishing this management area was to:

1. Establish a deer heard.
2. Increase this herd to huntable deer population.
3. Provide public hunting.

Steps one and two are complete. From deer browse checks made in this area it has been found that deer have increased to the carrying capacity of the range. The next step is to allow Louisiana hunters to reap the harvest this land provides. It is roughly estimated that about 250 deer can and should be taken off of this area each year.

In order to fulfill steps one and two the Commission has built and maintained roads and bridges; marked and maintained a boundary around the entire area; established and maintained eight supplementary food plots. In addition to this during the falls of 1955 and 1957 two weeks of managed squirrel hunting was allowed. During the 1955 season 1,758 hunts were made and 3,517 squirrels were killed. During the 1957 season 2,000 hunts were made and 4,000 squirrels were killed. This represents many pleasant hours spent afield.

DISTRICT II

Joe L. Herring
Supervisor

James R. Taylor
Biologist

Approximately five thousand acres is being developed in the northeast portion of Jackson Parish for public hunting. Object of this project is to disk or scarify the soil so as to promote the growth of native food plants such as lespedezas, legumes and others for quail, rabbits, and doves. Factors such as the disking of strips in relation to proper cover ad dispersal of the areas for good game management practices are taken into consideration.

Standard strips of approximately one-fourth acre are being disked, on contour where conditions require, each strip being at least fifteen feet in width and 300 feet in length. Applications of commercial fertilizer are being made as soil conditions require. In some instances common lespedeza and sesbania seed are being broadcast on the disked areas to supplement inadequate native species.

Guy Campbell, Biological Aid and Curtis L. Hollis, Game Management area supervisor, removing Lespedeza bicolor plants that have been "heeled in". These plants are to be distributed to landowners through the Soil Conservation Service for planting on farms.

Areas receiving this management practice are designated as public hunting areas.

FARM GAME HABITAT IMPROVEMENT

This project has been considerably reduced since it was put into effect in Louisiana in 1942. Analysis of information compiled over a 5 year period indicated the number of successful *Lespedeza bicolor* plantings were disappointingly low when the planting material was furnished to all individuals requesting seedlings. In 1956, a total of 240,000 bicolor and 10,000 multiflora rose seedlings were distributed through the various districts and in 1957, three hundred eighty-six thousand bicolor seedlings were distributed. During the three years preceding the current biennium the number of plants furnished through this project was approximately 500,000 to 1,000,000 each year.

The following table shows the number of seedlings distributed over the past two years:

	1956		1957
District	L. Bicolor	Multiflora Rose	L. Bicolor
1	25,000		15,000
2	80,000		150,000
3	5,000	3,000	16,000
4	10,000	2,000	8,000
5	10,000		5,000
6	10,000		6,000
7	100,000	5,000	186,000

Multiflora rose has enjoyed even less success than bicolor. After seven years, the writer knows of only a very few good rose borders in the state. None of this material was distributed in 1957. Cherokee rose, a close relative of multiflora, does very well over most of the state; so well, in fact, that it has become a pest in several parishes. For this reason, many people did not want to take a chance with a similar species.

TERZIA GAME MANAGEMENT AREA

Fred Freeland
Game Management Area Supervisor

The Terzia Game Management Area is located approximately five miles northwest of Bastrop, Louisiana, in the northwest portion of Morehouse Parish. It comprises an area of approximately 46,000 acres of mixed hardwood. The topography is gentle rolling terrain. The use of this land for wildlife management purposes has been acquired from the Crossett Lumber company on a long-term lease without fee.

Supplementary Food Plots for Turkey and Deer

Five areas comprising some twenty-four (24) acres were cleared for supplementary food plots by use of the Louisiana Wildlife and Fisheries Commission D-7 Dozer. After clearing the land, it was disked by use of an eleven (11) foot

Louisiana Wild Life and Fisheries commission personnel constructing a hog and cattle proof fence around food plots on the Terzia Game Management area.

disk. All plots were then plowed and disked with a Ford 860 Tractor. This was to prepare a better seed bed. Main purpose of these plots were for turkey utilization and management, with deer utilization second.

These areas were planted to wheat, hairy vetch, white Dutch clover, rye grass, Austrian winter peas, and crimson clover.

Fifty tons of lime was spread on the five food plot areas. This was done because of the lime deficiency in the soils of this area.

All plots were fenced against hogs and cattle. Six foot cresote posts were used with 30 inch hog proof net wire on bottom and two strands of barb wire on top.

Deer

The Terzia Game Management area is supporting a very good herd of deer. A small die-off of deer was noted during the late summer of 1957 and from browse indications the Terzia area is near its carrying capacity. Other surveys being conducted on the area indicate that the deer herd may be approaching problem conditions and some deer should be removed from this area in the near future.

Fred Freeland, Game Management area supervisor, on Terzia area checking food plots. Plots were planted for turkey management.

Turkey

Turkey counts are being conducted on the area and counts indicate that Terzia Game Management Area is supporting two or more flocks of turkey. Plans were made for an extensive turkey management project to be conducted on this area. However, this phase of work has been deferred temporarily.

A two week controlled squirrel hunt was planned for Terzia during the 1957-58 season but was cancelled.

Approximately thirty-five (35) miles of boundary lines were cleared of brush and painted; Game Management Area boundary signs were placed on these lines.

Commission personnel clearing turkey food plot on the Terzia Game Management area in Morehouse parish.

UNION PARISH GAME MANAGEMENT AREA

Curtis L. Hollis

Game Management Area Supervisor

The Union Parish Game Management Area is located in north central Union Parish and comprises an area of approximately 10,000 acres. It contains second growth loblolly and short leaf pine and mixed hardwoods with a heavy growth of underbrush. Selective cutting timber operations are being conducted on the area by landowners. Topography is rolling hills with top soil of sandy loam of the forested coastal plain type.

Through cooperation of Frost Lumber Company and several smaller landowners this area was established in 1949 as a Game Management Area. Olin Mathieson Chemical Corporation in 1951 purchased the lands of Frost Lumber Company on this area.

The Union Parish Game Management Area was acquired by the Louisiana Wildlife and Fisheries Commission for game

Edward C. Carlson, Federal Aid inspector from Atlanta and John D. Newsom, Pittman-Robertson coordinator, Louisiana, checking Federal Aid area in Louisiana.

management purposes with the cooperation of landowners on a long-term lease basis without fee.

Deer

Prior to the establishment of this Game Management Area there were no deer in this part of Union Parish. After the inauguration of this project 67 deer were released on the area.

These releases which were made from 1949 to 1951 have been most successful and the deer population is showing a very remarkable increase. Controlled deer hunts are being considered for this area in the near future.

Twenty salt licks are maintained throughout the year for deer. Ten to twenty pounds of salt per lick is used at each salting. Time of salting is once in the early spring and once in the fall of each year.

Turkey

During the preliminary investigation it was reported that a flock of wild turkeys used this area. A total of 144 game farm turkeys were released on this area during 1950 and 1951. Survival was very low on these birds; but turkeys are still on the area and from investigations conducted they are probably the native stock. These birds are reproducing at a slow rate but game management practices are being conducted to increase the flocks.

Five food plots totaling 25 acres were cleared, fenced, and planted to supplementary deer and turkey foods. Plants being used on these plots include crimson clover, singletary peas, hairy vetch, chufas, oats, wheat, and rye grass. Plots are maintained on a yearly basis with disking, mowing and reseeding when necessary. Plots are fertilized with 8-8-8 at the rate of 400 pounds per acre per year when needed.

Squirrel

Studies of movement and habits of fox squirrel (*Sciurus niger*) and gray squirrel (*Sciurus carolinensis*) are being conducted on the area by trapping, tagging and other methods. A total of 133 squirrels have been tagged on the area.

A very successful squirrel hunt was conducted on the Union Parish Game Management Area from October 18 to October 31, 1957 inclusive. Two hundred and two (202) hunters participated in the fourteen (14) day hunt killing 410 squirrels. Of this 323 were gray squirrels and 87 were fox. The average success ratio was 2.03 squirrels per hunter.

Five Lespedeza bicolor plots were planted on the game Management Area using 35,000 plants. Plots were planted for quail utilization.

Approximately fourteen miles of jeep road were brushed out during this period. An eight foot grader blade was purchased for use with the Ford tractor on road maintenance. The blade is being used on ditching and leveling existing roads as well as preparing new jeep trails.

The Wildlife and Fisheries Commission D-7 Dozer was used in constructing one game watering pond. This pond is approximately one acre in size.

Fences around the food plots were repaired. This included restapling wire where staples had pulled out and gate repairs.

The overnight cabin was maintained in a state of good repair. Personnel used the cabin while making turkey studies, counts, deer counts and other work pertaining to the area.

CHENIERE LAKE WATERFOWL DEVELOPMENT

Cheniere Lake is located in the central portion of Ouachita Parish approximately three miles south of West Monroe. This lake contains approximately 3,500 surface acres of water. The area has a medium growth of cut over cypress, gum and other bottom-land hardwood types. Waters on this area were lowered during 1956 for the purpose of harvesting timber; thus, the commission took advantage of this by planting duck foods. The lake was lowered to the 57.5 foot M. G. L. contour. After this drop the lake was approximately 1,200 surface acres in size. Dropping the lake to this level exposed many good areas suitable for waterfowl development.

One hundred and fifty pounds of *Eleocharis sp.* and *Scirpus americanus* seed were received from South Carolina for planting in Cheniere Brake. Three areas were selected for planting. Depth of water on these areas varied from six inches to one foot. Seed were planted broadcast on the water surface area. Reason for planting in this manner was that the water would be off of these flats within a matter of

Deer checking station on the Red Dirt Game Management area.

Earl Dean, Game Management Area Supervisor, issuing permits to F. J. Russell and John L. Webster on the Red Dirt Game Management area controlled hunt.

days; thus, leaving the seed on ridges or high areas with good seed beds.

During the time of planting approximately one inch of rain fell which helped very much in soaking and settling the seed.

John D. Newsom, Federal Aid Coordinator for Pittman-Robertson projects and Morton Smith, Biologist, weighing and checking deer on the Red Dirt Game Management area controlled hunt, December 1957.

Cheniere Brake furnishes some fair mallard shooting, thus these areas were planted for waterfowl use and will be observed for same. If *Eleocharis sp.* and *Scirpus americanus* proves to be successful on Cheniere, other areas may be planted to these species in the future for waterfowl.

DISTRICT III

Clyde E. Harrison
Supervisor

Roland P. Vernon
Biologist

Don Dennett
Biologist

During this period six game management areas were maintained in this district. Activities were diversified according to the potentialities of the various areas. Managed hunts were held for one or more game species on each. Species with high reproductive potential were hunted on all areas where this type of game was found, whether a high population existed or not. Technicians felt that even if some game populations were low inside the management areas, sportsmen should harvest a limited amount of the game present. Game species having a high reproductive rate are normally short-lived and will be found in large numbers only when breeding, food, and cover conditions are ideal.

In Louisiana such species should be harvested each year. Deer hunts, on the other hand, should be held only when deer populations have reached such a level that the herd needs reducing to preserve optimum range conditions. In spite of extensive trapping efforts and two managed buck hunts, deer range on one management area has been severly damaged. The range on another area has also been hurt considerably as virtually nothing has been done to reduce the herd in spite of efforts to trap and to have managed buck hunts. To restore the range on these two areas it is imperative that the herd be reduced considerably. For forest game such as deer and squirrels, little can be done of a practical nature to improve the range other than attempt to reach a satisfactory relationship between game production and land usage. On the management areas, where the land belongs to others, and not the Commission, game populations are managed so that as much hunting as possible is offered to sportsmen. Quail, on the other hand, are more compatible with various land uses. Small, scattered food and cover plantings can be used as an efficient tool in augmenting existing marginal populations. This tool has been used where conditions merit on management areas and the future will probably see increased food and cover plantings.

A glance at the accompanying chart will show managed hunts planned in District III for the period of this report and shows the number of hunting efforts as well as the kill. Knowing the season kill was 1.7 squirrels per hunting effort on a statewide basis one can see that the average kill on the management areas ranged from below the state average to slightly above. This shows that even if an area has not been hunted for a year or two, squirrel populations are no better than in areas that are hunted yearly.

Activities on the management areas are not all concerned with hunts. On all, fences must be kept up, boundaries brushed, painted and marked, jeep roads brushed and maintained, bridges built, and a host of other minor jobs. Deer trapping on Red Dirt, where 313 deer were removed and

Successful deer hunters having their kill checked at the checking station on the Red Dirt Game Management area controlled hunt, December 1957.

released in 13 other parishes is well worth mentioning. Forty-four deer were removed from the Catahoula Game Management Area.

Together with game harvested by sportsmen these areas serve another important function. It is here that much of the research data needed to manage all game species is obtained. The areas are needed for this purpose as conditions here can be controlled to a greater extent than on open lands. Such research studies include deer browse surveys, deer reproduction, deer travel, squirrel movements, oak mast production, quail food studies, and numerous others.

A "Load" of deer trapped on the Red Dirt Game Management Area and being released in Lincoln parish.

MANAGED HUNTS — DISTRICT III

Management Area		Squirrel 1956	Squirrel 1957	Deer 1956	Deer 1957	Quail 1956	Quail 1957***
Sabine No. 1	Hunting efforts	*	112				
	Total Kill		151				
Sabine No. 2	Hunting efforts	*	77				
	Total Kill		114				
Grant-Rapides	Hunting efforts	*	1410				
	Total Kill		2440				
Catahoula	Hunting efforts	*	748	*	1301		
	Total Kill		1361		26		
Evangeline	Hunting efforts	*	200		180**	*	177
	Total Kill		228		0		213
Red Dirt	Hunting efforts			*	2765	*	266
	Total Kill				86		341

* Hunts were planned, but cancelled
** Archery Hunt
*** The 1957-58 Season, actually February 1-10, 1958

Management areas in this district with their size and parish are as follows:

Sabine #1	8,000 acres	Sabine Parish
Sabine #2	12,000 acres	Sabine Parish
Grant-Rapides	7,700 acres	Grant-Rapides Parishes
Catahoula	40,000 acres	Win & Grant Parishes
Evangeline	15,000 acres	Rapides Parish
Red Dirt	36,000 acres	Natchitoches Parish

All are potential areas for managed deer hunts and have been instrumental in restoring huntable deer populations to their respective parishes.

DISTRICT IV

Dewey Wills
District Supervisor

Clifford T. Williams
Biologist

CHICAGO MILLS GAME MANAGEMENT AREA

Jim Perritt
Area Supervisor

The Chicago Mills Game Management Area is located in the western part of Tensas Parish and comprises approximately 29,500 acres of relatively flat, poorly drained, bottomland habitat. It extends from Cooter Point on the South to the Madison Parish line on the North. The entire area has been under lease from the Chicago Mill and Lumber Company since 1955, and harbors the following game species: deer, turkey, squirrel, rabbit, quail, and a few bear.

During 1956 a considerable amount of time was spent locating the best access routes into the area and selecting desirable sites for coming deer trapping operations. A general survey of the area was made with the main objective being the location of suitable sites for the planting of supplementary game foods.

In 1957 a great amount of time was spent cutting and painting boundary lines, and erecting boundary markers. Fire access roads were maintained with additional roads still in the planning stage. At the end of 1957 approximately 45 miles of old jeep roads had been brushed out, 32 miles of boundary line had been re-painted, 315 boundary markers had been replaced and 8 entrance signs had been erected on the area.

CALDWELL PARISH GAME MANAGEMENT AREA

Welch Lively
Area Supervisor

The Caldwell Parish Game Management Area is located on the southeastern portion of Caldwell Parish. It comprises about 11,000 acres of lands bordering Boeuf River and is covered by bottomlands. The topography is relatively flat and poorly drained and is largely covered by overcut oak and water hickory although scattered willow oak are to be found on the ridges. The entire area was leased without fee from private owners for wildlife management purposes.

Squirrel

A managed squirrel hunt was held on the area from October 18-October 24, 1957. A total of 182 hunters bagged 203

Photos showing park like effect on game management area due to excessive grazing by domestic stock.

squirrels. The hunter success was limited to a degree because of the weather conditions. The access roads on the Wildlife Management Area were practically impassable during the hunt therefore hunters were unable to make complete coverage on the area. Also it is believed that the success would have been better had the season opened on October 1 rather than October 18 as it was apparent that ground feeding of squirrels began in early October.

Turkey

A total of 269 game farm turkeys were originally released on the area. During the last gobbling check on this area (April 1957), a total of 12 gobblers were heard from three listening posts by three observers. The possible duplication on this area is unknown. Five gobblers were seen on the area and 9 gobblers and 2 hens were seen while driving from the area. The reproduction has been limited on the area due apparently to the spring overflows.

Four food plots with a combined area of about 18 acres have been cleared, fenced and planted to supplementary turkey food. The plots have been used extensively by deer and to a certain extent by turkey.

Deer

There has been a total of 93 deer released on this area. However it is estimated that the area now contains only 100-125 deer. Even though the restocking attempt on this game management area proper cannot be classified as successful, it has resulted in the establishment of shootable deer herd just west of the Ouachita River in the Bayou Dan Region. The deer herd has built up as a result of the general dispersal of deer from the game management area and a season will be recommended for this region in 1958.

The range on Caldwell Game Management Area would be capable of carrying a sizeable deer herd, however, due to the number of domestic stock (cattle, hogs, and goats), it is believed that the deer herd has reached its maximum size.

In February 1954, 10 exclosures were placed on the Game Management Area for the purpose of studying the effects of domestic animals on the deer range. Three of these fenced plots exclude deer, cattle, and hogs; three plots exclude cattle and hogs and four exclude only cattle. As would be expected, the greatest variation between vegetation composition in the exclosures and controls occurred in that area fenced against cattle, hogs and deer. There was a difference of 122 stems in favor of the exclosures over the controls in the hog, cattle and deer proof areas. The plots fenced against cattle and hogs had 8 more stems in the exclosures than in the controls while the plots fenced only against cows had 23 more stems in exclosures.

It is interesting to note that plants over two feet in

Supplementary food plots planted for turkey on Caldwell Game Management area.

Photos showing variation in vegetation within exclosures as compared to range free area outside.

height were more prevalent in exclosures than in controls.

It is also interesting to note that inside the fences, rank growths of herbaceous and woody plants are to be found, while just outside the fence where livestock range free the ground is almost completely bare and a browse line can be seen through the timber for appxoximately seven feet above the ground level. (see photos attached). From information gathered from the exclosures it is believed that the deer range would come back in about two years after removal of all stock from the area.

The only method by which this area can be utilized to its fullest extent is by the removal of cattle from the area. This would require that the entire area be fenced with a 4 strand barb wire fence. Until such time that the cattle are removed from this area, it is useless to do wildlife development work here.

CATAHOULA LAKE WATERFOWL DEVELOPMENT

To give a complete picture of the waterfowl development work being accomplished on Catahoula Lake, it may be advantageous to give a brief description of the area.

Catahoula Lake is classified as an "old river channel scar" and is located 20 miles east of Alexandria in central Louisina. The lake is a natural area and the open area occupies 21,000 acres. The area forms a boundary between the pine covered hills of LaSalle Parish to the north and the cypress-hardwood swamps to the south. When water levels are dropping, the lake drains out to the north and east through Old River and French Fork while Little River empties into the lake in the southwest.

The lake naturally follows a natural "draw-down principle" each year and is by far the best waterfowl area in north or central Louisiana at present. Water stands over the vast flat lake bed each year, until August, before beginning to recede. As the mud flats become exposed, the moist soil plants begin to grow in profusion and the lake bed appears to be a giant pasture. After the plants mature and form seed during late October, the water begins to gradually cover the mud flats, creating an ample food supply for waterfowl.

For the past 20 years encroaching stands of water elm and swamp privet have taken over and occupied approximately 4,000 acres of the mud flats and have curtailed the production of waterfowl foods.

In 1956 approximately 850 acres of very dense stands of water elm and swamp privet were cleared with the D-6 Caterpillar with the Collins brush blade attachment. In addition to this 850 acres, approximately 800 acres had been cleared in previous years and the results produced are considered to be very satisfactory. The area cleared during the previous year's cutting sprouted to a certain degree; however, sprouts were killed back during the months of inundation.

No work was accomplished on the waterfowl development area in 1957 due to high water levels on the lake bed.

DISTRICT V

Jack Sims
Supervisor

WEST BAY GAME MANAGEMENT AREA

Raymond Rowell
Area Supervisor

During the past two years most of the work done on the management area has consisted of maintenance.

All of the roads on the area have been ditched and drained. Culverts and bridges have been replaced where they were needed. All of the boundary lines have been cleared and boundary markers were replaced when needed.

An annual check on the turkey population is made every year druing the early spring months. The checks covered by this report show that several small flocks have been established on and around the area. There have been indications of some reproduction by the flocks, but no large increase in the total population has been noticed.

There is a very good deer population on and around the area. A six-day season during 1957-58 was allowed in the parishes surrounding the game management area. However, hunting was not allowed on the area. This hunting population is a direct result of the releases made on the management area.

During the fall of 1956 and 1957 acorn mast data was collected from the area. This work was done in cooperation and under the direction of the T.S.I. study which is being carried on over the entire state.

The salt licks for deer were maintained on the Area during the past two years. The food plots which consist of plantings of clover and rye grass were mowed and fertilized, but were not replanted during the two years covered by this report.

DISTRICT VII

Kenneth C. Smith
Supervisor

Henry D. Robert
Biologist

SOIL SCARIFICATION ON PUBLIC ACCESS LANDS

In March, 1956, a project was initiated in District VII to determine the feasibility of disking 1/5 acre strips over a large area for the purpose of encouraging the growth of quail food producing plants.

Three such areas were treated. The first was a 1,600 acre tract owned by Gaylord Container Corporation of Bogalusa, Louisiana; the second was 1,810 acres owned by International Paper Co., and the third, 920 acres owned by J. H. McClendon of Amite, Louisiana. All three areas are in Tangipahoa Parish.

On each of these tracts, a 1/5 acre strip was disked every 20 acres. The strips were approximately 15 feed wide and

Preparing seed bed for fenced food plot on Tangipahoa parish.

Soy beans growing in fenced food plot on Gaylord Container corporation land in Tangipahoa parish.

500 feet long. Of the 75 strips on Gaylord Container land, 37 were seeded with common Lespedeza at the rate of 9 pounds per strip and fertilized with 50-60 pounds of 5-20-20 commercial fertilizer per strip, 9 strips were seeded to common Lespedeza at the rate of 5 pounds per strip with no fertilizer, 24 strips were seeded to chocolate weed at the rate of 6 pounds per strip with no fertilizer and five strips were disked which received no seed or fertilizer.

Sixty plowed strips were established on International Paper Co. land and none of these were seeded or fertilized. Of the 45 strips on the McClendon tract, 16 were seeded to chocolate weed, unfertilized, and 4 seeded to goatweed, unfertilized.

A fair stand of common lespedeza was obtained where the strip was fertilized, but cattle damage was very severe. On the unplanted, unfertilized plots, the production was far short of that necessary to effect a material increase in the carrying capacity of the area.

It was also determined that the cost of operating a Model 860 Ford tractor for an operation of this nature was $3.24 per indicated hour (1 hour at 1515 RPM). This figure will be useful in determining probable costs of a similar project in the future.

Since unsatisfactory results were obtained with the scarification (disking) as such, a plan was proposed to the Gaylord Container Corp. whereby Gaylord and the La. Wild Life and Fisheries Commission would share the cost of establishing 38 fenced food plots on the 1,600 acres mentioned above. The Gaylord Corp. agreed to do this and work was begun in April, 1957. All plots were approximately ½ acre in size (100 ft. X 200 ft.) and half of each was disked and fertilized. Nineteen of the strips were seeded to soy beans and nineteen left unplanted to determine the amount of natural reproduction which would occur in fertilized, fenced areas.

The soy beans produced a good crop before the first frost and the seeds began to drop shortly after the beginning of the quail season. The "Pelican" variety of soy beans were used in this work and proved to be very satisfactory.

It was not expected that the planting done in this area would materially affect the carrying capacity of the land, but merely concentrate the birds for the 1957-58 hunting season. Present plans call for the establishment of *Lespedeza bicolor* strips within each of the 38 fenced plots. If this planting is a success it should add to the natural capability of this piney woods area to produce quail.

DISTRICT VIII

Robert A. Beter
Supervisor

This district was established July 1, 1957 and the work has been primarily concerned with the acquisition of areas that may be developed as public waterfowl hunting areas. The following discussion deals with three areas in varying phases of acquisition which have received primary attention.

Bonnet Carre Spillway

This public shooting ground, comprising 3324 acres, is situated 28 miles from New Orleans and just north of the Baton Rouge-New Orleans Highway. This floodway was leased by the Commission from the Corps of Engineers.

Present tentative plans call for the impounding of waters from a point adjacent to Lake Pontchartrain and paralleling the east and west borrow pits and running south to a point approximately one-fourth mile from the Baton Rouge-New Orleans Highway. This impoundment will be divided by an access road running north-south through the area. Each side of the impoundment will be controlled by its own water control structure. Such structures are to be used to so fluctuate water levels as to ensure optimum aquatic growths. The provisions of adequate aquatic vegetation should provide attractions for many waterfowl particularly diving ducks, such as scaup (dos gris) which rest in such abundance on Lake Pontchartrain.

Biloxi Marsh Lands

An area consisting of roughly 40,000 plus acres of the finest potential waterfowl area in the southeast marsh. This area, located in St. Bernard Parish, is accessible by boat from Hopedale, Ycloskey, Shell Beach, Dollut's Canal, the Rigolets and Chef Menteur. It is located between Bayou St. Malo and Bayou LaFe on the west and east respectively and by Lake Borgne on the north and Bayou LaLoutre and Lake Eugene on the south. To exploit the potential of this valuable marsh, it is necessary to control or stabilize the waters of the numerous ponds and lagoons found scattered throughout the area. This function will be accomplished by means of wooden, water control structures which will allow an influx or outflow of water to any degree desired. Such structures will ensure minimum water levels required for growths of wigeongrass (*Ruppia maritima*) even during the most extreme low tides. These water control structures serve the dual purpose of not only providing stable low water levels for plant growth but in also providing water areas in which to hunt.

Besides the myriads of dabbling and diving ducks which inhabit this marsh each fall and winter, blue and snow geese stop to feed on the recently burned areas. Such burns destroy the dominant or climax vegetation of wiregrass and cordgrass which offer little or no sustenance to foraging flocks of geese. When this vegetation is burned, new succelent growths of *Scirpus olneyi* and *S. robustus* emerge and provide excellent and obtainable food for the geese. By controlling the areas burned, it is possible to provide emerging vegetation through the winter; a prime necessity if geese are to be held on an area. If the whole area is burned at one time, within a month or so the emerging vegetation will grow too high to be utilized by the flocks. Such a situation would cause the geese to leave this marsh for fertile areas where food is more obtainable. This marsh, after being burned, is also utilized heavily by Wilson snipe.

Wisner Public Shooting Ground

Another public shooting ground comprises approximately 30,000 acreas and is located between Leeville and Grand Isle. It is bordered on the north by the Southwest Louisiana Canal, on the east by Caminada Bay, on the south by the Gulf of Mexico and on the west by the Leeville-Grand Isle Highway.

As in the situation pertinent to the Biloxi Marsh area, the same improvements are planned on this tract of land. The area is easily accessible by boat from any bayou or canal intersecting the highway between Leeville and Grand Isle.

As with any operation of public shooting grounds by the Commission, it is the aim and policy to provide hunting and fishing opportunities for the maximum number of individuals. Acquisition of all these areas will be affected prior to July 1, 1958. It is hoped that the public will support and encourage this type of program, and that in the future more areas can be obtained, improved and opened to the public.

A STATISTICAL SURVEY OF GAME AND FISH HARVEST AND MANAGEMENT DATA

CHARLES R. SHAW
Project Leader

The statistical survey of game and fish harvest and management data was set up as a cooperative Pittman-Robertson and Dingell-Johnson Project in 1953. It operated as a questionnaire type of survey with the questionnaire forms being sent out to a mailing list compiled by a modified random method from the hunting and fishing license receipt books. Actually Dingell-Johnson did not participate until the second year although a little information on fishing was secured from the first questionnaire. Important financial information was included in the material for the last two years. Comparative information, mainly in the forms of tables and/or graphs will be given in this report. During the first year the services of a statistician at the Louisiana State University were secured on a consultant basis in an attempt to set up a sound procedure for securing the desired information.

An attempt was made to interview a percentage of the non-respondents the first season but this proved too expensive and time consuming for the funds and personnel available. However, the very valuable information on the variation in the returns of the people who answered the questionnaires and those who did not send in their answers but who were later interviewed, was very necessary to provide a basis for adjusting the raw data. There is a strong bias for both a larger amount of hunting and greater success in the returned mail questionnaires and this must be allowed for in trying to make complete state-wide computations.

The returned questionnaires were edited and coded and the information transferred to punch cards. A part-time student operator was used initially; gradually as the work load on the machine increased and a sorter, as well as, the Remington-Rand key punch was secured, it was necessary to get a full time operator. (The Remington-Rand key punch and the Remington-Rand counting sorter were bought in cooperation with Dingell-Johnson Project F-1-R and Pittman-Robertson Project 29-R to be used on a variety of research problems.)

The project leader believes that the information secured on squirrels, ducks, doves, rabbits, quail and deer, although subject to a varying degree of bias will prove valuable as a base for further studies and for compartive purposes. However, the number of returns from the less favored species are too few to permit them to be considered reliable without further confirmation.

It is probable that the financial aspects of the survey will be useful as a confirmation of the value of our natural resources in Louisiana in the light of the amount of money spent in connection with hunting and fishing activities.

The break-down of information in the tables by parishes and/or districts is for the purpose of determining what differences exist between the different areas and whether they are such as to warrant special consideration and action. It was felt that these were needed in addition to tables giving more general information.

It is felt by the project leader that the project has been greatly handicapped by not having the services of a bio-statistician experienced in game management problems at least available for consultation and preferably to set up and guide the whole project. In the event that this project is reopened later for making a comparative study or a similar project is set up, it is most strongly recommended that the services of an experienced and competent bio-statistician be secured as project leader.

The material from which these reports are made, being in the form of tabulating cards stored in special cabinets, will remain available for re-examination or for purposes of special studies at any time. These may be used for re-evaluation in the event that another similar study is set up at a later date.

In the fishery questionnaire, a little additional information was secured regarding the extent of salt-water fishing and similar activities.

Unfortunately, there was no feasible way to include a large segment of the fishermen in the survey as many people in Louisiana are not required to buy a fishing license and we have been unable to devise a satisfactory method of getting a random sample of the non-licensed fishermen. It was hoped that the fresh water creel checks would provide this information but this portion of the work depended entirely on the cooperation of others and had to be abandoned. If carried out as planned, it would have given state-wide coverage on a twelve month basis. Since then a law has been passed excluding resident women from the necessity of purchasing a fishing license, therefore it is impossible to secure complete coverage of fishing activity and pressure.

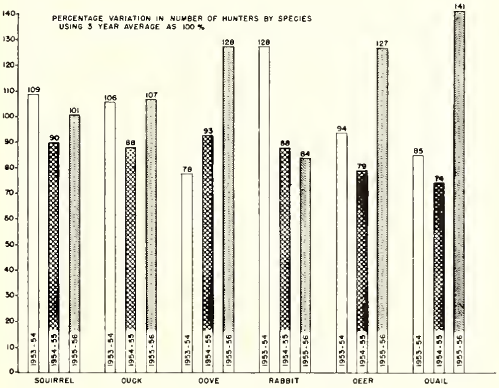
The method of obtaining the mailing list is a modified random one, consisting of the random selection of a number between one and twenty and starting on that name in the first license receipt book, thereafter simply counting and taking every twentieth name. In the event that there is not a complete address or for some other reason that name cannot be used, then the previous name is used but the count is kept the same. The random selection of each name in compiling a mailing list of several thousand would otherwise entail entirely too much time and expense.

It is unfortunate that due to the delay in the return of all license books from the various parishes etc., it was necessary to go back two years for the names for the mailing list. This of course means that you are not actually sampling the list for the season indicated. It also means that a certain percentage of people have moved within the state or out of it, thus reducing the percentage of useable returns. There also appeared to be a number of fictitious addresses included, especially in some of the larger towns near the border of the state. Hence, there is reason to believe that quite a few out-of-state people are buying the resident licenses and merely giving any address that comes to mind.

The adjustment of the returns for subsequent surveys was made on the basis of the 1953-54 survey because no further interviews were made. In the event this type of survey is used again, it would be wise to include plans for a suitable system of interviews of non-respondents.

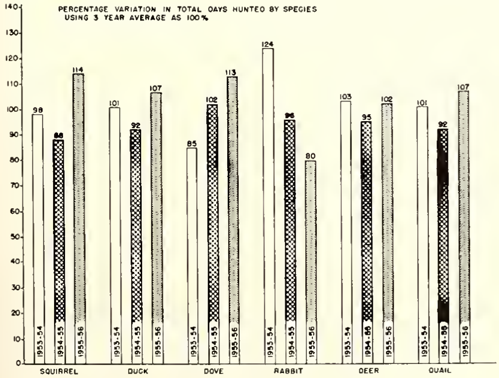
The final summary of the game portion of the survey for the three hunting seasons was made up as a set of six tables and three bar graphs. There is a table for each of the six most important species showing the comparative figures for both raw data (based directly on questionnaire returns) and adjusted data (adjustment made on basis of the returns from the interviews made for the 1953-54 season) for the three seasons. The figures shown still include some bias in varying degree, but still may be valuable for comparative purposes and as an indication of the relative importance of the various species and relative hunting pressure and kill. Probably the deer and quail data are biased to a greater extent than the others although waterfowl is also subject to considerable prestige bias.

GRAPH No 1

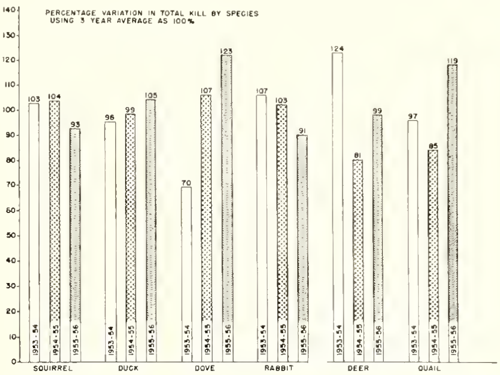


In setting up the three bar graphs to give a visual representation of the comparative values for the three hunting seasons, an average of the three years was used as a base or 100% and the variation shown in comparison to the three year average. It may be noted that doves increased steadily from year to year in number of hunters, amount of time spent in dove hunting and in total kill while the reverse was true in the case of rabbits. Varying fluctuations occurred in the other species.

GRAPH No. 2



GRAPH No 3



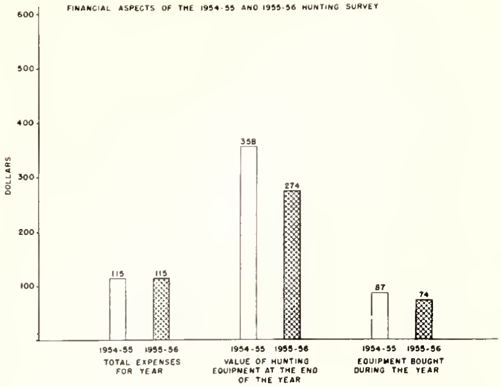
In conclusion the project leader wishes to state that while the results shown are not free from bias, they do represent a basis from which reasonable and practical inferences can be drawn concerning the hunting pressure and kill of the important game species of Louisiana.

The portion of the survey dealing with fishing is not quite as elaborate as that concerned with hunting. The fishing portion was added later so that data from only two years are available. In this report the financial information from the 1954 season was made up in a set of eight tables, a breakdown by districts for the state, and breakdowns by parish for each of the seven districts. All of these tables are self-explanatory. Two things might be emphasized as bearing on increased amount of expenditures shown in connection with fishing as compared with hunting expenditures; in the first place, in Louisiana fishing is done on a year-round basis (no state-wide closed season on fresh-water game fish) and in the second place the extent of the available water in the form of streams, bayous, lakes, etc., (also open twelve months of the year) may influence the tremendous number of boats and/or motors owned by Louisiana fishermen. As with the game survey, in some instances the returns from individual parishes may be too few to precisely reflect the true picture for that parish; however, on a district and/or state basis the figures should be reasonably reliable. At the present we have no method of measuring the natural proclivity of fishermen to prevaricate concerning their piscatorial prowess. No interviews were carried on in connection with the fishing portion of the survey. No attempt has been made to measure expenditures, preferences and success on non-licensed fishermen due to the impossibility of securing any approximation of a random mailing list. In general the mechanics of handling the fishing survey was the same as for the game survey.

An extremely large percentage of Louisiana fishermen own their own motors. The figures running approximately 84% for ownership of motors; approximately 64% for ownership of boats; and approximately 20% for ownership of trailers. Of course this does not take into account the fact that many fishermen own more than one boat and/or motor, which would reduce the percentage of owners somewhat.

The fishing portion of the survey shows some interesting information regarding fishing preferences, catch, expenditures, etc., but due to the large number of unlicensed fishermen in the state it is impossible to estimate, with any degree of accuracy, the total figures for the state. Applying the individual averages to the total number of licenses sold will give a minimum figure for the state as a whole but at

GRAPH No 4



present there is no feasible method of even estimating the percentage of fishermen who do not buy a fishing license. An attempt was made to secure a mailing list through Fresh Water Creel Checks made by personnel of the Enforcement Division but this had to be given up when use of these Creel Checks was discontinued.

In the event that it ever comes to pass that all Louisiana fishermen are required to secure fishing licenses, this type of survey could be used to secure information which would give total figures for the state. In the meantime some valuable information has been disclosed and a basis set up for future comparisons. This project was terminated as of April, 1957.

Returns from Game Survey — 1955-1956

STATE TOTALS

Game	Percentage of Hunters	Average No. of Days Hunted	Daily Average Kill	Seasonal Average Kill
Squirrel	55.75%	11.55	2.01	23.25
Rabbits	23.75%	9.21	1.91	17.58
Deer	27.30%	5.11	.07	.35
Quail	38.79%	4.99	2.87	14.33
Doves	42.72%	4.78	4.26	20.39
Ducks	45.11%	9.18	1.92	17.66
Geese		6.68	1.41	9.40
Coots		6.90	3.40	23.46
Wilson Snipe		2.12	3.48	7.39
Woodcock		1.53	2.76	4.23

Gerry Kenny, student assistant, separating bottom samples taken from the Ouachita river in the Louisiana Wild Life and Fisheries commission's pollution studies on fish.

Returns from Fishery Survey — 1955

FINANCIAL SEGMENT

District	1955 Expenses Av. Per Person	Value of Equip. at End of 1955 Av. Per Person	Bought During 1955 Av. Per Person
I	$242.61	$445.47	$106.41
II	202.99	342.66	78.44
III	247.29	593.98	138.03
IV	136.44	316.79	78.19
V	209.82	465.89	103.26
VI	277.98	655.51	110.62
VII	304.34	601.39	193.22
Total for State	$261.97	$529.14	$137.11

Returns from Game Survey — 1955-1956

FINANCIAL SEGMENT

District	1955-56 Expenses Av. Per Person	Value of Equip. at End of 1955-56 Av. Per Person	Value of Equip. Bought During 1955-56 Av. Per Person	Pct. of Hunters Who Bought 1955-56 Waterfowl Stamp
I	$109.60	$264.85	$71.02	50.88%
II	85.76	265.40	67.60	68.96%
III	91.50	311.80	91.82	41.46%
IV	171.06	354.32	131.80	74.07%
V	81.73	252.90	64.91	25.00%
VI	120.16	389.04	80.22	26.25%
VII	139.30	403.39	92.64	26.50%
Total For State	$114.91	$273.56	$73.42	40.04%